

LOTO IMPLEMENTATION BY CARRYING OUT ENERGY SOURCE ANALYSIS

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ABSTRACT:

This study aimed to analyze the correlation of LOTO system that has been implemented in MANDO, involving the LOTO training, supervision, and reward and punishment with the LOTO implementation behavior of the Maintenance Engineer. This research was observational with cross sectional study. Samples were 50 respondents taken by simple random sampling with a population of 97 Maintenance engineers. Data were analyzed statistically using Chi Square test ($\alpha < 0.05$) and continued by observed value of phi coefficient. The results showed that most of the Maintenance engineers in the Maintenance Engineers & Production Department. Mando Automotive India Pvt Ltd had implemented LOTO in every maintaining and servicing equipment well. Statistical analysis showed the variables have a significant correlation with LOTO application on Maintenance engineers was supervision (sig = 0.047; phi value = 0.312). LOTO training, reward, and punishment did not have significant correlation with LOTO application. In conclusion, supervision had significant correlation with LOTO implementation on Maintenance engineers. Mando Automotive India Pvt Ltd should increase transfer knowledge to Maintenance engineers by putting LOTO signs around shop floor, increasing supervising role of the maintenance engineers and OSHE Department, making a LOTO training and refresh training schedule and evaluating it, and also giving rewards to Maintenance engineers regularly.

Keywords: *LOTO, OHSE, Maintenance Engineers,*

1.INTRODUCTION:

LOTO (Lock Out Tag Out) is the physical restraint of all hazardous energy sources that supply power to a piece of equipment, machinery or system. LOTO also includes applying a Warning Tag on the physical restraint device. LOTO operations must be done on all equipment, machinery or system Shutdowns before Authorized Personnel can perform repairs or service. Most equipment and machinery has an Energy Isolation Device. These Devices are

usually put into the off position to shut down the hazardous energy source. Physical restraints (Lock Out Devices) can be put onto the Energy Isolation Device and secured with padlocks.

Examples of Lock Out Devices include: ball valve and gate valve lockouts, circuit breaker lockouts, plug and wall switch lockouts and pneumatic lockouts.

The total shutdown and restraint of all hazardous energy sources including the safe release of stored hazardous energy (e.g. capacitors and pressure in a line) must be

accounted for. Lock Out Tag Out (LOTO) is a system of locking and labeling on an energy source of isolation equipment. LOTO aims to protect Maintenance engineers on maintaining and servicing. Application of Lock Out Tag Out is influenced by behavior.



2. LITERATURE SURVEY

This study aimed to investigate cases of workplace accidents due to LOTO system failures. We evaluate the investigations' results to find the root causes of LOTO system failures and to find the solutions as the control actions. We might use the results of the investigation and synthesis as a control pattern model for the other similar companies. Lockout/Tagout procedures are implemented to protect workers, especially maintenance workers in manufacturing or

service industries which involves machines or processes with hazardous energy. The implementation of the LOTO system is not difficult, but often industry faces problems in its implementation. The problems that occur mainly because of human failures in running the procedure and lead to the system working failure. Notoatmodjo [12], which states that positive reinforcement factors such as giving awards, praise, and bonuses will change a person's behavior to be more obedient to the procedure. Behavioral changes tend to be easier if the individual gets benefits by changing behavior. According to Heni [16], consistency is needed in the implementation of reward and punishment to maintain their impact. Hopefully, with consistent reinforcement of reward and punishment, the rewarded behavior will always be implemented, and the punished behavior will gradually disappear. According to Heinrich (1930) in Ramli [2], the supervisor is a key element in the implementation of OSH program. Lack of supervision is the biggest source of accidents. Somad [10] stated that every production activity will always go through changes in the process, so that existing rules and procedures must be adjusted and updated periodically following those changes. All procedures, work instructions, standards, and forms including those associated with LOTO will always be audited internally and externally. (OSHA [1]), The LOTO system is designed for non-activation mechanisms. It is also designed for the termination of energy sources' flow into machinery or equipment before any corrective or maintenance action is taken. Therefore, in this system, some persons have the

authority to lock and tag symbol for the energy isolation process to prevent the release of hazardous energy and ensure that energy has been effectively isolated. Locking equipment works to enable energy insulation equipment in a safe condition, i.e. the 'off' position. This mechanism prevents the machine and equipment from getting energy supply and always in a controlled position because no one can remove without a key or have to go through a unique unlocking mechanism using a particular tool. The marking equipment is a prominent warning sign that indicates that the device has been locked and alerted other workers not to activate the machine during the repair or maintenance process. Implementation of a right and correct LOTO system is expected to prevent accidents, injuries or casualties during the maintenance process. (Campbell [2], Bulzacchelli et al. [3], Mehrgani et al. [4]). A review of earlier studies related to the LOTO system, grouped into two focuses, i.e. research on the LOTO system implementation analysis and research on the optimization of production systems that apply the LOTO mechanism. Analysis of the LOTO procedure implementation was done in eight sawmills in Canada to identify their respective advantages and disadvantages. (Poisson and Chinniah [5]). In the implementation of the LOTO procedure, employee attitudes and supervision are significant factors that affect its success, so it is important to be noticed. (Hapsari and Ardyanto [6]). Charlot et al. [7] developed a manufacturing system optimization model with a preventive maintenance system using LOTO procedure and without LOTO

procedure. The results of this study are similar to Halimah's research [11], which states that there is no significant relationship between safety training and a person's working behavior. can be minimized by effectively using ergonomic interventions.

3.OBJECTIVES:

This procedure is to provide minimum requirements for lockout and tag out of energy- isolating devices to protect any Person from hazardous energy including

1. electrical,
2. mechanical,
3. hydraulic,
4. pneumatic, or any other energy

It is used to ensure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources and locked out before employees perform any servicing or maintenance where the unexpected energizing or start-up of the machine or equipment or release of stored energy could cause injury.

4.METHODOLOGY:

1. The study was conducted from Aug 2020 to Sep 2020, while data was taken from Aug to Nov 2020. The population of this research were all Maintenance Engineers & Production Department. MANDO who met the inclusion criteria, for a total of 97 Operating Engineers . Based on the large sample computation and formulas, the minimum sample for this research was 49 Operating Engineers. Sample determination for questionnaires in this research used

simple random sampling, because the population was relatively homogenous.

- The management schedule and plan to implement LOTO system with effective overall organization specially utility equipment's such (power house, DG, Compressors and remaining) and Shopfloor area such (machining & assembly) lines with two phase method.

4.1 METHODOLOGY PROCESS

- Identify the problem
- Describe how to carryout the LOTO Implementation
- Create LOTO Manual
- Providing the training to the Maintenance Engineers
- Identify the list of machines, study Energy types, & how to control the energies
- Create colour code for types of energies & list of energies with machine number
- Print the colour code stickers & paste at respective isolation point
- Create procedure for each machines – Derivation from how to control Energy apply LOTO
- Evaluate & procure zone wise LOTO Kit requirements
- Provide physical training to respective zone authorised employees with LOTO Kit & fill the LOTO forms.
- Link LOTO with maintenance log book & work permit.
- Leadership audit to be carried out in monthly basis.

13. Conclusion

4.2 PROBLEM IDENTIFIED

| INCIDENT REPORT | | CASE STUDY | | | | | |
|---|-------------------------------|--|--|------|-----------|-----|-----|
| Date / Shift / Time | 11/08/2020 / 10:18 AM | Location | HBA-1 | TEAM | In charge | NOT | NOT |
| Machine | Diaphragm Assembly gross pump | Experience | 4 Years / Month | Item | | | |
| Victim Name / ID | M. B. Yanaq / H08172 | Designation | Senior Engineer | Item | In charge | NOT | |
| Category | LTI | Detail of injury | Diagnosed index finger distal epiphysis Amputation | Item | | | |
|  | | Incident description: While attending a break down in gross pump in HBA-1. The engineer's right hand index finger got trapped inside the piston assembly. Root Cause: • Occurrence cause - Maintenance engineer inspected the piston assembly by his hand without what of the air pressure, piston not get actuated and the index finger got trapped between piston and cylinder housing. • Procedure cause - No additional Safety shut off valve available to release the pressure. Corrective Action: • Awareness given to all maintenance engineers to ensure Shut off the air pressure while attending any problem in all pneumatic or peacock equipment. PFD to be prepared, communicated & display. • Additional shut off valve to be provided to allow the air pressure. • Horizontal deployment enable so per each client attached. (Link - BMSA/ISSM & CGM.) | | | | | |
| | | | | | | | |

4.3 FUNCTIONAL SAFETY CONCEPT

Functional safety is based on the concept of Risk Reduction

- A Risk Assessment is performed to quantify the hazards on a machine
- For each hazard, risk is reduced by adding layers of protection

The Safety system runs in parallel with the Production system. Focus of the Production system is Output. Focus on safety system is Protection of workers





4.4 AUTHORIZED AND AFFECTED EMPLOYEES TRAINING BY METHODOLOGY

- Authorized employees
 - Purpose of the procedure
 - Recognition of applicable hazardous energy sources
 - Type and magnitude of the energy available in the workplace
 - Means and methods necessary for energy

isolation and control

- Ways to verify that energy isolation is effective

- Affected Employee

- Instruction on the purpose and use of the energy control system
- Awareness
- Advise to not touch or interfere

5. LOTO RESULTS

5.1 The Maintenance Engineers characteristics

The Maintenance Engineers characteristics of Mando. MANDO Maintenance Engineers showed that most of them were older than 30 years old, high schools graduate or equivalent, had been working for over 46 months.

5.2 LOTO training

This study results showed that most of respondents (58.0%) had attended LOTO training and the rest (42.0%) had not.

5.2.1. Supervision

In accordance with the study result, it was noted that more than half of the respondents (84.0%) said that supervision by foreman toward LOTO implementation in workplace had been good already, and only few respondents (8.0%) said that supervision by foreman toward LOTO implementation in workplace had been low.

5.2.2. Reward and punishment

Based on the study results, it was noted that almost all respondents had considered the reward, but the rests (10.0%) assumed there was no rewards. Most respondents (76.0%) had considered the punishments, but the rests assumed there was no punishment still

5.3 LOTO implementation by

Maintenance Engineers

Based on study results, it was noted that almost all respondents (60.0%) had already implemented LOTO well while doing maintenance and repairing the equipment, while the rests (40.0%) had not implemented well while doing maintenance and repairing the equipment yet.

5.4 Relationship between LOTO training and LOTO implementation by Maintenance Engineers

Respondents who implemented LOTO well and had attended LOTO training are 62.1 percent, whereas the number of respondents who implemented LOTO well but had never attended LOTO training are 57.1 percent. There is statistically no significant relationship between LOTO training and LOTO application because of the significance $(0.953) > \alpha (0.05)$.

5.5 Relationship between supervision and LOTO implementation by Maintenance Engineers

The respondents who implemented LOTO well and reported good foreman supervision were at 66.7 percent. Respondents who implemented LOTO well but reported that the supervision was not good enough were at 25.0 percent (Table 1). There is a statistically significant relationship between supervision and LOTO implementation because of the significance $(0.047) < \alpha (0.05)$. Knowing that there was a relationship between supervision and the application of LOTO, the value of coefficient phi is then 0.312. Supervision had a weak relationship with the application of LOTO to Maintenance Engineers because the value of 0.312 approached the value zero,

meaning it had a relationship that was getting weaker.

5.6 Relationship between reward and punishment with LOTO implementation by Maintenance Engineers

The number of respondents who implemented LOTO well and considered rewards in the company were 62.2 percent, whereas the respondents who implemented LOTO well, but had not noticed that there was a reward in the company were 40.0 percent (Table 1). The respondents who implemented LOTO well and considered punishment in the company were 55.3 percent, while respondents who implemented LOTO well but assumed there was no punishment in the company were 75.0 percent. There is no statistically significant relationship between rewards and LOTO implementation because of the significance $(0.377) > \alpha (0.05)$. There is no statistically significant relationship between punishment and LOTO implementation because of the significance $(0.317) > \alpha (0.05)$.

6.IMPLEMENTATION OF LOTO

6.1 Lock Out Tag Out implementation for Maintenance Engineers at MANDO

OSHA Standard 29 CFR Part explains that Lock Out Tag Out (LOTO) system must be applied when there is equipment maintenance and repair activity. LOTO system aims to avoid hazardous energy release as the effect from unexpected start-up of the equipment by automatic or manual control. It can cause critical injury even fatality to the person who does that work. The Mechanical & Production department authorized management of heavy equipment to support

the production process, including maintenance and repair. The Maintenance Engineers department has a core business process, which is the maintenance and repair of the production-process support equipment. This supporting equipment is all heavy equipment units and is directly related to the achievement of company production targets. The OSHA Standard 29 CFR Part 1910.147 [9] point (c) of the General represents that companies should have documented hazardous energy control procedures and provide facilities for the application of the LOTO system. MANDO had already committed to apply hazardous energy control procedures during maintenance and repair work through the Lock Out Tag Out (LOTO) system in Maintenance Engineers al & Production department. X actualized the commitment in compliance with LOTO facilities and procedures as well as procedures, work instructions, standards, and forms related to the application of the LOTO system.

6.2 Relationship between LOTO Training and Lock Out Tag Out (LOTO) by Maintenance Engineers

OSHA Standard 29 CFR Part 1910.147 [9] points (c) of the General explained that in the energy control program through the Lock Out Tag Out system, the company has to provide training for the maintenance and repair worker. The standard of OSHA 29 CFR Part 1910.147 [9] points (c-7) on the Training and Communication sub points (i) and (iii) that explains that the company should provide and refresh training to ensure that the objectives and functions of the energy control program are understood by both the repair

and maintenance worker. Training also aims to improve knowledge and skills in the safe use of LOTO. There is no statistically significant relationship between LOTO training that was followed by respondents with LOTO implementation. The results of this study are similar to Halimah's research [11], which states that there is no significant relationship between safety training and a person's working behavior. This is in accordance with the opinion of Notoatmodjo [12], which states that behavior arises from the experience of a person and factors outside the person is known, is believed to cause the intention to act.

6.3 Relationship between supervisor and Lock Out Tag Out implementation by Maintenance Engineers

Supervision is required to enforce applicable OSH regulations. According to Listyandini[15], despite the already mandatory OSH rules, the effect of these regulations will be weak if not combined with good supervision as well. According to Heni [16], supervision should ensure the procedure is obeyed by the worker. Unsafe conditions and behavior that can trigger accidents will be known from the beginning, and the company can immediately take preventive efforts and apply improvements to solve these problems.

This research showed that there is a significant relationship between supervision and LOTO implementation. The role of supervisors was ensuring the application of LOTO procedures to Maintenance Engineers s through the active actions in controlling the work of each Maintenance Engineers under his supervision. The results of the study are

in accordance with the results of Halimah [11], research showing that supervisors are the most dominant factor related to safe behavior when working. In this research, safe behavior was realized in LOTO implementation. The results are similar to the Listyandini [15] study, which states that there is a significant relationship between supervision and person's behavior when working.

7.4 Relationship between reward and punishment and Lock Out Tag Out implementation by Maintenance Engineers

There is no statistically significant relationship between the presence of reward and punishment with the application of LOTO. This is because the Maintenance Engineers had been aware of their responsibilities as equipment repair and maintenance workers who have to apply LOTO due to the working procedure. Although there is no statistically significant relationship, according to the results of research, most respondents who considered rewards applied LOTO well. This is reinforced by the opinion of Notoatmodjo [12], which states that positive reinforcement factors such as giving awards, praise, and bonuses will change a person's behavior to be more obedient to the procedure. Behavioral changes tend to be easier if the individual gets benefits by changing behavior.

The study results showed that respondents who assumed there was no punishment in most companies actually implemented LOTO well. This is in accordance with the opinion of Notoatmodjo [12], which states that punishment is only suitable to increase

the motivation of short-term behavior only. Changes in behavior caused by punishment will not last, because someone will always be afraid of doing something wrong. Notoatmodjo argued that to obtain long-term effects in behavioral change, positive motivation in the form of rewards is more appropriate. Giving rewards will increase the spirits of a person and his co-workers, and thus encourage safe behavior at work.

7.CONCLUSION

The ability for the MAIL Steering Zone to prevent future, particularly catastrophic injuries will depend on following the recommendations discussed in this chapter. Continuing with a 'business as usual' approach, where a procedure on hazardous energy control is unclear or procedures are vague, will at best leave the absence of incidents or near misses to chance. Operating an effective Utility facility will require the MAIL to establish and maintain a sound, well-designed and well-communicated energy control and LOTO procedure.

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