International Journal of Applied Science and Engineering
Citation: *IJASE*: **6**(1): 01-10, June 2018
DOI: 10.30954/2322-0465.1.2018.1

Implementation Strategy of Lock Out and Tag Out (LOTO) Electrical Systems for Paper Industry

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ABSTRACT

Safety has always been important part of the paper Industries. The main objective of this research work was implementation of Lockout and Tag out (LOTO) systems in electrical panel board to minimize the hazards and injuries in paper industry. Many processes with hazardous energies have been identified in paper mill in electrical and mechanical section maintenance work. Hazardous energies like electrical, chemical, gravity, thermal, hydraulics, pressure etc. were handled with utmost precaution control of these hazardous energies ensures and enhances safety precaution. Also verified the influence of human error during preventive maintenance and activities on the optimal safety stock levels using an extension of the hedging point structure. By successful implementation of LOTO system, the maintenance cost, inventory cost, and factory accident, frequency and severity rate of incidents were reduced.

Keywords: Hazardous Energy, preventive maintenance, Lockout and Tag out (LOTO), Safety

On September 1,1989, OSHA issued a final rule on the Control of Hazardous Energy (Lockout Tag out) in Volume 29 of the Code of Federal Regulations (29 CFR), Section 1910.147, this gone into effect on January 2, 1990. It helps the safety of workers from hazardous energy, while they are performing servicing or maintenance on machines and equipment's by identifying the practices and procedures necessary to shut down and LOTO machines and equipment's[2]. Discussed above Paper production involves the higher dangers in industry and has electrical panel board and electrical power, ventilation, drainage, pressure gas, lifting and transport systems which have great energy and were driven by air pressure, hydro mantic and electricity. If the energy leaked unfortunately, it may lead to injury or death may be happen. Because of this in paper industry it was necessary to implemented LOTO system for safety purpose. The aim of LOTO system was to instruct the paper industry to establish management model for maintaining or servicing, prevent accident, keep the safety situation stable, and get zero-injury goal finally.

This system was safety procedure process; this was highly effective method among others so it was used in various industries, research organisations it helpful to ensure that the dangerous machines were switched off[7].

The sample of a physical lock was put on the electrical switch and key was kept with the service person so that no one could not make the switch ON while service person working on electrical panel. This was implemented as per Factories Act-India, (OSHA) Occupational Safety and Health Administration, USA. With these detailed LOTO procedures were un able to result in zero accidents. Many accidents have been happened due to non-adherence of LOTO procedure. The LOTO procedure has many men dependent activities and possibilities human error. LOTO was implementation through this research work by verify the equipment's and activities without any compromise on safety on various section in the paper industries[15]. Discussed that the use energy in almost everywhere and everything. Industries also have many equipment and processes which uses energy and some of the energy could be harmful. They used use different type of hazardous energy like electrical, pneumatics, hydraulics, chemical, and potential etc., paper industry machines. The person working with or near to the machine must use hazardous energy control procedure Lockout placing a lock on an energy isolating device according to an established procedure, that ensures that the fixture, equipment, electrical panel boars or machinery cannot be energized until the lock was removed by the person who placed lockout device that utilizes a positive means such as a lock to hold on energy-isolating device in a safe position and prevent the energizing of fixtures, electrical equipment or machinery. Tag out devices on an energy-isolating device, in the machinery shutdown and that the equipment or machinery must not be operated until the tag out devices was removed by whole placed. Tag out was a warning device, such as a tag was means if attachment, that can be securely fastened to an energy isolating devices accounting to the procedure. The tag helps to find out whether it machine or panel attached to it. Weather it was operated until the tag out device was removing. Group lockout, when two or more works were working on different parts of a larger overall system was LOTO device was first secured with a folding scissors clamp that has many padlock holes capable of keeping it closed. Tag out each worker has signed off on their portion of research and removed their padlock from clamp. LOTO has five required components to be fully compliant with OSHA law. The LOTO was a method of keeping the equipment from set in motion and endangering workers. The verification step in the lockout procedure often neglected by workers for various reasons: improper training in worker, don't follow up the work permit system. Moreover, energy-saving systems present additional difficulties for lockout. This case involves in study of industry extruder used to apply LOTO.

Hazardous energy and isolation

Electrical board panel can make much adverse effect on workers from things like electrical sparks, electrocution sources. Disconnecting or marking safe the equipment involves the removal of all energy sources and it called as isolation. Electrical instrumentation isolation let's take a look at one of the major ways instrument manufacturers provide high-voltage safety-isolation. While isolation physically and electrically separates two parts of a circuit, the two parts can interact. The isolation was achieved by using electromagnetic field coupling between the two circuits. The three most commonly used methods were opto couplers (light), transformers (magnetic flux), and capacitive couplers (electrical field) isolation provides several advantages, it breaks ground loops, and it improves common-mode voltage rejection. It permits the two parts of the circuit to be at different voltage levels, which means one can be safe while

the other side was at hazardous voltage levels, For isolation to be safe, it needs to have two things -- high-integrity isolation components (opt couplers, transformers, capacitive couplers) and a safe insulator barrier. For example, this insulator can be a piece of plastic, a keep-out space in a PWB, or an air gap.

How much insulation makes product safe

- Working isolation voltage (voltage across the isolation barrier) - larger isolation voltages require more insulation.
- Transient voltage (temporary voltage spikes across the isolation barrier) - insulation strong enough to withstand the normal working voltages of the circuit can break down under large transients. Therefore larger transients will require more insulation.
- Air pollution - insulation can be reduced by contaminants in the air. Dirtier environments require more insulation.
- Single-fault current path - if the insulation breaks down, can the shorted current go through a human body? If so, a larger amount of insulation was required

In United States, (OSHA) names several hazards in construction safety and health they were four, of this electrical hazard was one of them. After many years of studies and corresponding mitigating of electrical hazards there were adopted for safety measures. Construction workers still get electrocuted in the workplace every year[10]. Data from the U.S. Bureau of Labour Statistics (BLS 2014) showed that 51.1% of nationwide electrical fatalities occurred at construction sites in 2013. In manufacturing system planning was very important there were many types such as operation activities, failure evaluation activities, maintenance activities, injuries and material supply, as well as fluctuation in customer demand, occur research and field staff to evaluate machine safety, including compliance with OSHA standard 1910.147 for control of hazardous energy, commonly known as the(LOTO) standard. However, employee ability to self-audit was not assessed, leaving a gap related to providing both employers and workers a tool with which to assess hazards independent[23].

Table 1: Hazardous and their Examples

Hazardous	Examples
Structural	Sharp edges, projections
Mechanical	Entanglement crushing, cutting
Physical	Electricity, pressurized content, noise, vibration, hot and cold temperatures
Ergonomic	Awkward working position, manual
Slip	Poor walkways, railings
Chemical	Gases, fumes, liquids
End Use Conditions	Location, impact on workplace layout
Biological	Bacteria, mould

Workers intervene on machinery in all three phases that was installation, operation, maintenance, trouble shooting, repairs, adjustments, set up, handling production disturbances, cleaning and dismantling and they were exposed to hazards. Please note that the context for COHE used in this paper was broader than that used in OSHA 1910.147, which is focused on using (LOTO). Here, COHE describes all controls

used to safely de-energize equipment to prevent injuries that might occur from the mistaken belief a hazardous energy source was disabled.

The OSHA COHE regulation only applies to electrical hazards, citing one or more of the followings; The laser system was in normal operation mode, The laser's activation warning system prevents unexpected hazardous laser radiation, The laser hazard can be disabled by removing a master key, The engineered laser safety system can be used instead of LOTO because it provides an effective alternative energy control system that could be used as machine guarding or as part of an administrative lockout. The OSHA-LIA alliance acknowledges that ANSI Z136.1 addresses all laser safety requirements. (Note that the focus of this alliance was on training, education, outreach and communication to prevent hazardous laser exposures. It does not indicate that the OSHA 1910.147 regulation does not apply to laser hazards.) These cited reasons were in corrected and inadequate for laser hazards. In us resulting there were 592 LOTO related. Totally there were 624 fatalities were reviewed. In the majority of cases (70%), lockout procedures were not attempted at all. There were very few incidents in which a lockout attempt was made and a fatality occurred due to e human error (5.2%) or mechanical failure (1.2%). This small proportion suggests that LOTO procedures, when properly used, do indeed prevent fatalities. Several strategies to increase the use of LOTO were proposed. The author recommends further research on understanding barriers to following LOTO procedures and finding ways to increase usage of these procedures. Shaw (2010) reviewed 100 incident investigation reports in the UK spanning the period 2002–2007 and identified a number of contributory causes. This review revealed to that LOTO inadequate were:

- Design
- Failures to isolate
- Defeating protecting system
- Inadequate fault reporting

  - Maintenance were major contributors[20] and[2] retrieved from the French EPICEA database, 88 accidents between 1998 and 2007 involving machinery during non-production phases (i.e. maintenance). The study reports that operators also perform maintenance actions. The distribution of non-production phase machinery accident according to the risk factors were classified as: organizational aspects (69%) corresponding mainly to compliance with procedures, in particular isolation/lockout, technical aspects (51%), i.e. maintainability, lack of protection or inadequate protection and human aspects (15%), i.e. operator has insufficient knowledge associated with risk assessment in particular. The phase during which the accident occurred was analysed. The distribution of non-production accidents according to phase were classified as: preventive maintenance (32%), i.e. cleaning, setting, testing, inspection activities, corrective maintenance (30%), i.e. combination of repairs and troubleshooting activities, diagnosis (15%), re-commissioning (14%), i.e. adjustments and tests after maintenance and before returning to equipment operation phase, malfunction (8%), i.e. activities aimed at rectifying unforeseen production incidents mainly due to jamming of raw materials[6]. Workers who were required to carry out tasks in the danger zone of a machine when performing repairs, maintenance or unjamming activities must follow lockout Procedures, unless safe alternative methods exist and could be applied. Moreover, energy-saving systems create additional difficulties for lockout. This case study involves a paper

board extruder used to apply plastic on paperboard The approach adopted here can be used for other\ machines and will help improve worker safety during interventions by ensuring correct application of the Lockout procedure[17]. The objective of this paper was to minimize Work In Process (WIP) and finished goods inventory costs; it also aims to respect the essential space time during intervention on machine down, in order to minimize the possibility of the circumvention of protection devices or of the retraction of LOTO procedures through a passive redundancy system. This paper therefore verifies the effect of passive redundancy on optimal stock levels [21]. Detailed above two-fold. This first sought to verify the influence of LOTO and corrective maintenance rates on two modes of failure in a manufacturing system consisting of one machine producing one type of part. Secondly, added a standby machine, which differed from the main machine to monitor the influence of passive redundancy within our system. Clearly that passive redundancy optimizes production and maintenance costs while enhancing occupational safety. Even greater benefits accrue if effective LOTO and maintenance planning occurs in concert with production control[13]. This section presents the results in this classification was based on, which shows the main elements of a lockout program. Also presented in the subsections to compare

- The content of standards and regulations,
- Lockout programs sawmills,
- Lockout practices it was implemented and our recommendations to be changes needed.

REVIEW WORK

The main objectives of this paper was to understand how LOTO program actually working in electrical panel board it helps to better understanding of practises, purpose, and Improvement in LOTO system the goal of this system was safety of machinery, workers and electrical panel board in paper industry by hazardous energy.

Article 185. Making secure: Subject to the provisions of section 186, before undertaking any maintenance, repair or unjamming work in a machine's danger zone, the following safety precautions shall be taken: (1) turn the machine's power supply switch to the off position, (2) bring the machine to a complete stop, and (3) each person exposed to danger locks off all the machine's sources of energy in order to avoid any accidental start-up of the machine for the duration of the work. Moreover, article 186 of the RSST provides an alternative to lockout under specific circumstances and it states that: Article 186. Adjustment, repair, unjamming, maintenance and apprenticeship: When a worker must access a machine's danger zone for adjustment, unjamming, maintenance, apprenticeship or repair purposes, including for detecting abnormal operations, and to do so, he must move or remove a protector, or neutralize a protective device, the machine shall only be restarted by means of a manual control or in compliance with a safety procedure specifically provided for allowing such access.

This manual control or this procedure shall have the following characteristics: (1) it causes any other control mode or any other procedure, as the case may be, to become inoperative, (2) it only allows the operating of the dangerous parts of the machine by a control device requiring continuous action or a two-hand control device, and (3) it only allows the operation of these dangerous parts under enhanced security conditions, for instance, at low speed, under reduced tension, step-by-step or by separate steps.

The CSST recently revealed that in 3 years, more than 230 derogations to article 185 have been issued by inspectors. It also appears that lockout is not well-known in various industrial sectors in Quebec[22].

Identified LOTO follow up

LOTO follow up plant maintenance work, equipment would be change and plant under shut down maintenance work. The electrical disconnection and to control internal energy the safe maintenance work and operations to use the LOTO system follow up process.

Methodology

LOTO under safety system

LOTO would be log out release some condition followed by:

- ❒ Line clearance
- ❒ Work permit system

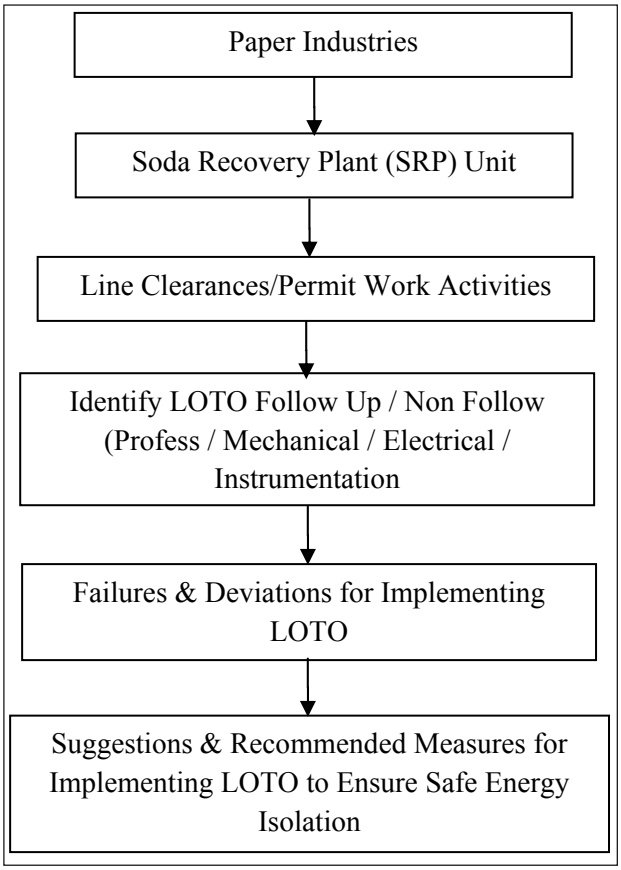

Fig. 1: Methodology

Line clearance (LC) was the energy release to internal and external energy (example electrical energy release and mechanical energy release that was isolation process) Work permit system was the following the worker to maintain the company formats was process control, mechanical control, electrical control, instrumentation control. non-follow up the not knowing the potential rise of energy isolation, in adequate training to works the electrical equipment lack at time management to following safety system for energy isolation, over confidence of the work activities, standard operating procedures should not be following, while engaged in maintenance and shutdown work. Failure deviation for implementing Suggestions recommended measure for implementing LOTO to ensure safe energy isolation. LOTO system of various components like above equipment's mentioned and equipment's which having the potential of self-acting in part of isolation failures were all to be included in the safety systems under LC and work permit to ensure safe isolation. Equipment is idle machines, electrical panels, motors and pumps, chemical storage tanks, pressure vessels, self-acting machines, conveyors. Failure gap identified inadequate information, instruction, training and supervision for the safety systems. By passing the standard operating procedures for the safe maintenance.

Electrical panel maintenance work Arc Flash Mitigation Study

Developing an optimal arc flash protection strategy for a given facility can be difficult due to the number of solutions and system variables involved. Effective were flash hazards reduction was overall system production strategy that accounts for safety operational requirements as well as system reliability and availability.

Electrical failures

Arc flash hazards as "a dangerous condition associated with the possible release of energy caused by an electric arc pane board". High-energy arcing fault can cause significant damage to electrical equipment as well as significant injury to workers exposed to such an event. Flash incident energy level, Installation of warning labels on equipment, Training employees on risk assessment and risk control method, Use to proper arc rated personal protective equipment(PPE), Exposure in energy releases, Equipment failure, System failure, Contract employee (un education people), Improper ventilation, Machine failure Two factors combine to determine the actual risk that workers may face

In many facilities, the highest incident energy levels will be found at the service entrance equipment, fed directly by the utility sources. However, if workers rarely have to interact with this equipment. Their actual exposure to elevated hazard levels was infrequent. It may be more desirable to first focus on minimizing incident energy levels at locations where worker exposure was more frequent, even if that leaves the hazards level at a few locations above an otherwise undesirable threshold or limit. In other instances, it may be possible to address worker exposure to certain tasks by using solutions that help remove workers from the "line of fire" rather than directly affecting the indirect energy. These can include remote operation of switch devices, remote racking of withdraw able breakers, and installation of infrared windows or embedded thermal monitors to allow for some maintenance activities to be performed without requiring workers to be directly exposed to arc flash or shock electrical hazards. Effectively, this allow for prioritization of "risk" vs. "hazard "reduction. A number of different engineering controls for arc flash hazards are available, and developed and introduced of the market on a regular basis. Regardless of the solution type, though, they can be grouped into one of four main categories: prevention, reduction, avoidance, and containment. More detail on the relative performance of each solution category was given below. A summary of the key characteristics of several common mitigation types/strategies were shown.

Instrument Data

Table 2: Panel Board Electrical Power Supply-110kv Yard Supply

Sl. No.	Activity	Equipment	Failure Gap Identified	Recommended Action	Remarks
1	Chemical dosing LP agitator changing	Chemical dosing LP agitator	Process lock not provided	To provide the LOTO system	To be followed
2	Secondary SETP motor pump repairing work	Panel no 23 Secondary SETP unit	Old type of starter so there was no provision available for LOTO	To change the LOTO provision in panel board	The new LOTO system implemented in wire rope method

3	Drain value changing work	Emergency drain value-3 TAG:MV 5122 Pipe line	Under line clearance tag not displayed in panel board	To provide the line clearance from	To be maintain
4	Screw conveyor maintain work	Salt cake screw conveyor(ENMS)	Mechanical lock not provided in panel board	Proper training employees trained	To be followed
5	Condensate pipe line welding work	Condensate pump TAG:M110-014	Non- availability of LOTO locks	The new lock equipment provided	To be maintain
6	Pipe valve changing work	Feed water pump-2	Inadequate training for the line clearance systems for providing LOTO	Proper training and LC from provided	To be followed
7	Discharge value changing work	Discharge value TAG:MV50	No provision for provided LOTO as like old type shorter	To change the new shorter or wire robe type LOTO provided	To be followed
8	Pipe line dismantling work	Week white liquid pump TAGNO: M110-009Liquid bulb pulp line	Non- availability of personnel's or in charge for providing LOTO System	Proper experience employees handling	To be maintain

DISCUSSION

It was beneficial for Paper industry that has a panel board in which it was difficult to verify the zero energy state. It was a safety system that monitors LOTO operations. This type of LOTO system will most likely be installed increasingly often in the future was electrical panel board and may compromise worker safety if the risks were not properly assessed and analysed and if the solution is not adapted to the problem. The paper industry of dedicated safety-related equipment could design a device for verifying the absence of voltage that would be connected directly to the safety system in place on electrical panel board, pipe line and that would be both procedural (visual verification) and systemic (work permit system). This would strengthen the reliability requirements specified for validation systems in standards and regulations for paper industry.

CONCLUSION

LOTO was the suitable method to carry out several tasks in danger zone such as electrical, mechanical and maintenance work, there by installing LOTO system we could be to minimise the problems and effect of hazardous energies. The originality of this system lies in its zero electrical energy verification procedure, which was reliable, user-friendly and based on safety-related control systems for electrical panel board; it could be applied to other energy sources and other equipment. The verification system was an integral part of the machine and electrical panel safety system and implementation to the strategy. Based on LOTO design process, this article also makes recommendations regarding several implementation standards.

We ensure that this system has more advantage then other method, like many paper industries prepare themselves to adopt this method for safety of workers. This was also helpful in maintenance of equipment.

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