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HAZARD IDENTIFICATION & RISK ASSESSMENT FOR MACHINE IN A MANUFACTURING INDUSTRY

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Abstract—This paper aims to HAZARD IDENTIFICATION & RISK ASSESSMENT FOR MACHINE IN MANUFACTURING INDUSTRY the process of evaluating the risks to safety and health arising from hazards while working in machines, which forms an integral part of the Occupational Safety and Health Management System, whereby all hazards are identified and evaluated taking into consideration existing control measures. The exercise should be carried out by competent persons in the field. The aim is to eliminate or minimize risks at work through tightening of control measures. The risk assessment process may also identify the training needs of employees and contribute towards the building of a preventative safety and health culture. In this endeavour, the commitment of management, employees and competent persons are important in carrying out a proper risk assessment. Risk Assessment is an important tool in the creation of safe working conditions thereby increasing productivity and employees' morale while reducing injury, sick leaves, and labour turnover. It also aims at cost reduction as accidents and illnesses are
costly to the injured/diseased person, the close family, the organization as well as the State. The objectives of this guideline are to assist employers and employees' representatives to have a better understanding and to put into application a uniform approach of Risk Assessment. Risk assessment is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognized threat.

INTRODUCTION

(Risk Management and Legal Compliance) requires all managers to periodically review the risks that arise in their respective areas and then implement an effective system of internal controls to manage those risks. Further guidance on implementation of this Policy is provided in:
The Management Process on Risk Management, which has been adopted as a common approach to risk management across BIL in all business areas
EHS Guideline (EHS Risk Assessment and Management) which sets out a preferred approach in relation to EHS risks.
All managers with responsibility for the operation or maintenance of machinery should therefore ensure that they are familiar, not only with this document, but also with the above Policy and Risk management process.

PROBLEM IDENTIFICATON

Failure of Human Systems

An analysis of the past accidents reveals the human factor to have caused for over 60% of the accidents, while the rest are due to other plant component failures. This percentage will increase if only major accidents alone are considered for analysis. Major causes for human failures reported are due to:

- Stress induced by poor equipment design, unfavourable environmental conditions, fatigue etc.
- Lack of training in safety & loss prevention
- Indecision in critical situations

- Inexperienced staff being employed in hazardous situations.

Often, human errors are not analyzed while reporting accidents and accident reports only provide information about equipment failures.

Hazard Assessment and Evaluation

Preliminary Hazard Analysis (PHA) is based on the philosophy "Prevention Is Better than Cure". Safety is relative and implies freedom from danger or injury. But there is always some element of danger or risk in anything we do or build. The purpose of preliminary hazard analysis is to identify early in the design process the potential hazards associated with, or inherent in, a process design, thus eliminating costly and time consuming delays caused by design changes made later. This also eliminates potential hazard points at design stage itself. Hence, preliminary hazard analysis is more relevant when a plant is at design/ construction stage. This technique, applied early in the project life cycle, helps eliminating hazard and, thus, to avoid costly design modifications later. This analysis fortifies the process design by incorporating additional safety factors into the design criteria.

Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. This is followed by consequence analysis to quantify these hazards. Finally, the vulnerable zones are plotted, for which risk reducing HAZARD IDENTIFICATION AND RISK ASSESSMENT measures are deduced and implemented. The various process activities involved in this pulp and paper mill operations are:

- Raw material handling and preparation
- Chemical Pulping
- Stock Preparation
- Paper Making & Processing

Except for chemical pulping and chemical recovery from black liquor, all the other processes involve purely mechanical operations that are not complex or hazardous. Chemical pulping involves cooking of raw material with sodium hydroxide at temperatures below 1750 C. No major hazards are expected from this process. Sodium hydroxide is a mildly hazardous chemical in nature. Hence, no major hazards with the potential for any emergency situation exist in the process plant.

Maximum Credible Accident Analysis (MCAA)
Damage Criteria

Unloading at the storage facility may lead to fire. The damage criteria due to an accidental release of any hydrocarbon arise from fire is not toxic and hence no effects of toxicity are expected.

Fire Damage

The fire in the solid raw material can be of point of consideration. The liquid chemicals are nonflammable in nature and the lubricant oils can also be considered in the same context. n.

OBJECTIVE AND METHODOLOGY

A. ***Objective of the Project***

This assessment should be comprehensive in scope and identify all potential health and safety risks present, including machinery risks. However, where the general risk assessment identifies machinery risks, additional more detailed machinery risk assessments should normally be carried out. In fact, machinery risk assessments are required for all but the simplest items of work equipment. Risk assessment documentation should ensure that there is a cross-reference between the general health and safety risk assessment and the more detailed machinery risk assessment

The results of machinery risk assessments should feed into higher level risk assessments carried out at the departmental, value stream at site level. Significant machinery risks should appear on relevant risk registers to ensure that they are visible to senior management.

Regularly-occurring safety audits offer myriad benefits to organizations, as well as their employees, contractors, and customers:

- improved workforce safety
- fewer accidents, injuries, and illnesses
- lower workers' compensation costs

- fewer legal claims
- less regulatory uncertainty and compliance risk
- less turnover
- greater productivity
- improved employee morale
- improved efficiency
- improved publicity and reputation
- better decision-making

B. ***Methodology***

Machinery risk assessments are, by their nature, relatively detailed and complex. They also require input from a range of different people (see above). As a result, they require the allocation of significant site resources. For these reasons, when a BIL facility introduces a formal machinery risk assessment programme for the first time, it is usually appropriate to draw up a schedule of machinery risk assessments to spread the work over a defined period of time. The schedule should be prioritised according to the perceived level of risk and should take into account:

- The age of the machine;
- Whether there are known issues or weaknesses in the machine's safeguards;
- The frequency and duration of use;
- The number of people required to use the machine;
- The level of manual intervention during operation;
- Any history of injuries or near misses associated with the machine.

New machinery brought onto site should be subject to machinery risk assessment as part of the installation and commissioning process. Where factory acceptance tests are carried out, these too should incorporate a preliminary machinery risk assessment, which can be reviewed and adjusted during subsequent site installation and commissioning.

Questionnaire

Incident History

Before starting the assessment, the team should identify any machinery- related incidents that have occurred in the past and collect relevant information about the circumstances.

Physical inspection

Before starting the risk assessment, it is critically important that the team visit the work area to carry out a thorough visual inspection of the machinery in use, together with its associated services and safeguards.

Observe associated work activities, whenever feasible. In addition to normal operation, these activities may include start-up, shut-down, cleaning, jam clearing, line clearance, tool changes, common maintenance and repair work. (If any activities cannot be observed, it is important to ensure that the people who carry out those activities are involved in the risk assessment so that they can describe the activity to the other members of the risk assessment team.)

If machinery is not in use at the time of the assessment, the assessment should typically be rescheduled.

Carrying Out the Assessment

A standard form/template should be used to complete machinery risk assessments. This has the benefits of:

providing a checklist to ensure that all key issues are assessed;

Providing a consistent way of recording machine information and the results of the assessment.

An example template is included in Appendix 1.The following sections describe the main sections within this template.

Section A: Information about assessment

Some basic information about the machine, including a unique identifier, should be recorded. Once the assessment is complete, the date of the assessment and the names of the assessors should also be documented. The final assessment should also be discussed with the relevant line manager(s); it is good practice for the manager to formally approve the assessment by signature.

Section B: Identification of hazards

Hazards

Machinery risks that have not been recognised can neither be assessed nor managed. Each machinery risk assessment should therefore start with a physical inspection of the machinery and its operating parts to identify the hazards present. The template includes a short checklist of physical machinery hazards. If other hazards are identified at this stage (eg noise, chemicals, ergonomics), this should be noted and a subsequent check made to ensure that these have been captured by the relevant general health and safety risk assessment. (Separate risk assessments focused on these other risks may be required. However, they may be ignored for the remainder of the machinery risk assessment process.

Risk Factors

There are a number of risk factors which can significantly increase the risk of machinery-related injuries, particularly the risk of entanglement, eg wearing jewellery or long hair, using rags to clean equipment. These factors should be considered and recorded where applicable.

Section C: Analysis of machine

Once the hazards and risk factors have been identified, the next step should be to undertake a detailed analysis of the machine and its existing safeguards. The analysis should include a review of the:

- Location/environment;
- Controls;
- Arrangements for isolating energy sources and dissipating any stored energy;
- Safeguards;
- Emergency stops;
- Facility for overriding interlocks;
- Safety signs.

The above analysis should seek to establish whether the safeguards identified are effective.

Do they provide complete protection against all the hazards identified?

Are they of the correct type/design?

Are they in good working order?

In addition to this basic analysis of the machine and its safeguards, the assessment should review arrangements for training and for preventive maintenance of safeguards, etc

Section D: Interlock category assessment

If the machine's safeguards include interlocking movable guards, then an interlocking category assessment should be carried out, following the basic method set out in European Standard EN 954:1997 (Safety of Machinery – Safety related parts of control systems: Part 1. General principles for design.) If the machine is CE marked, then this assessment should have already been carried out prior to supply, and in many cases can be obtained from the manufacturer. If the assessment cannot be obtained from the manufacturer, then the category assessment should be carried out as part of the machinery risk assessment. The required category should then be compared with the actual category present on the machine

Data collection

DATE:

S.no	Machine/Equipments																	
		Emergency Stop Switch	Emergency Return Switch	Interlocking Door/Safety door	Two Hand push button	Photo Sensor: Covering entire door accessible area	Electrical Cable Routings/ Power line	Condition of control panel /pendent	Hot surface protection / labling	All the Guards are fixed properly	Illumination at workplace	Oil/coolant leakage	Storage of tools & materials	LOTO Provisions	Machine platform/ hand rails	Pedal operated switch/ Guard	All the moving /rotating parts covered	Remarks
	TPYE OF CONTROLS	A	A	A	A	A	B	B	B	A	B	B	B	A	B	B	A	
1	M1239-ENTER PRISE LATHE.2215/2000	NOT OK	OK	NA	NA	NA	OK	NA	NA	OK	OK	NA	OK	NOT OK	OK	NA	OK	2906
2	M1241-BATLIBOI MILLING M/C.	NOT OK	NA	NA	NA	NA	OK	NA	NA	OK	OK	OK	OK	NOT OK (MCB)	OK	NA	NOT OK	6414
3	M1271-LSL-3 CNC LATHE	OK	NA	IK OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	NOT OK	OK	NOT OK	OK	OK	OK	4456
4	M1277-LSL-0 CNC LATHE	OK	OK	IL NOT OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	NOT OK	OK	OK	NA	OK	OK	932255
5	M1295-RIGI20 CNC TURNING CENTRE	OK	NA	IL NOT OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	OK	OK	NOT OK (MCB)	NA	OK	OK	8543
6	M1300-LSL-0 CNC LATHE	OK	NOT OK	IL NOT OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	NOT OK	OK	NOT OK	OK	OK	OK	932504
7	M1303-AL2 CNC LATHE	OK	NOT OK	IL OK	NA	NA	OK	OK	NA	OK	OK	OK	OK	NOT OK (MCB)	NA	OK	OK	934955
8	M1449-HMT ECONO CNC 26 LATHE	OK	NOT OK	SAFETYDOOR OK	NA	NA	OK	OK	NA	OK	OK	NOT OK	OK	NOT OK	OK	OK	OK	6484
9	M1474-BOCCA CENTRELESS GRINDING BMS-R50-CF.	OK	OK	IL NOT OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	OK	OK	OK	OK	NA	OK	934597
10	M1278-LSL-0B CNC LATHE.	OK	OK	IL NOT OK/ SAFETY DOOR OK	NA	NA	OK	OK	NA	OK	OK	NOT OK	OK	OK	OK	OK	OK	934287

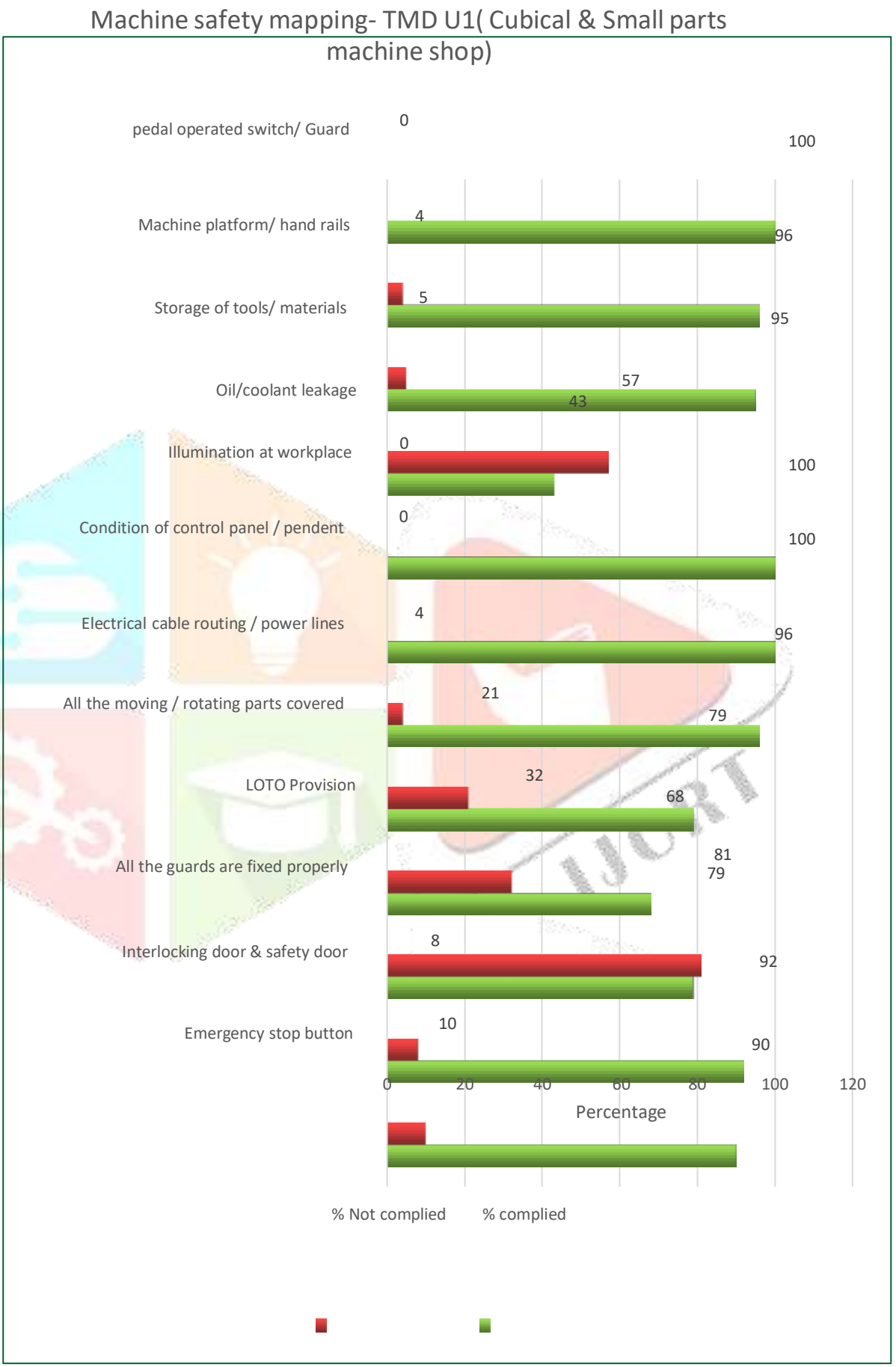
NOTE:
OK- WORKING GOOD /COMPLIED
NOT OK- NOT WORKING/NOT COMPLIED
NA- NOT APPLICABLE

Note:

Checked By: Name:
Signature:

Reviewed By: Name:
Signature

Machine mapping



RESULT & DISCUSSION

After conducting the hazard identification and risk assessment for a machine in a manufacturing industry, the following hazards and risks were identified:

1. Mechanical Hazards:
- Moving machine parts: The rotating or reciprocating parts of the machine can cause injuries, such as crushing, lacerations, or amputations.
- Flying debris: During machine operation, loose materials or fragments can become projectiles and cause harm to operators or nearby workers.
- Pinch points: There are areas where two moving parts come together, creating a pinch point that can result in injuries.

2. Electrical Hazards:
- Electric shock: If the machine's electrical system is faulty, operators or maintenance personnel can be exposed to electric shock, which can be fatal.
- Fire or explosion: Electrical faults can also lead to overheating or arcing, causing a potential fire or explosion risk.

3. Chemical Hazards:
- Exposure to hazardous substances: Some manufacturing processes may involve the use of chemicals, such as solvents or cleaning agents, which can lead to respiratory or skin irritation, or long-term health effects.

4. Ergonomic Hazards:
- Poor workstation design: Incorrect ergonomics in machine operation can cause musculoskeletal disord.

5. Pinch point hazard: The machine may have moving parts, such as gears or rollers, that can catch fingers or hands, causing severe injury.

- Risk assessment: The risk is moderate to high, as pinch point accidents can result in crushed or amputated fingers. Implementing safeguards like safety guards, emergency stop buttons, and proper training for operators can reduce the risk.

6. Noise hazard: The machine may produce high levels of noise during its operation, which can lead to hearing loss for operators if adequate hearing protection is not provided.

- Risk assessment: The risk is moderate, as prolonged exposure to high noise levels can cause permanent hearing damage. Noise control measures such as installing soundproof enclosures, providing ear protection, and regular monitoring of noise levels should be implemented to reduce the risk.

7. Chemical hazard: The machine may use or produce hazardous chemicals, such as lubricants or cleaning agents, which can pose health risks if not handled properly or if there is accidental exposure.

- Risk assessment: The risk is moderate, as chemical exposure can lead to respiratory issues, skin irritations, or even long-term health effects. Implementing proper chemical handling procedures, providing personal protective equipment (PPE), and conducting regular safety audits can minimize the risk.

8. Falling object hazard: The machine may have components or materials that can fall or be dislodged during its operation, posing a risk of injury to operators or nearby workers.

- Risk assessment: The risk is moderate, as falling oxtensive damage, injuries, or loss of life. Controls such as regular maintenance, training on fire prevention and response, and having appropriate fire suppression systems and equipment in place can help mitigate the risk.

Overall, conducting a thorough hazard identification and risk assessment for the machine in a manufacturing industry is crucial for ensuring the safety and well-being of operators and workers. By implementing appropriate controls and continuously monitoring and improving safety measures, the risks associated with the machine can be significantly reduced.

To mitigate these identified hazards and reduce associated risks, several control measures can be implemented:

1. Engineering Controls

- Install machine guards: Physical barriers should be installed to prevent access to moving parts, reducing the risk of injury.
- Use interlocks and emergency stop buttons: Machine interlocks should be installed to ensure the machine does not operate when guards are open. Emergency stop buttons should be easily accessible in case of emergencies.
- Implement proper ventilation: In areas where there is a potential for chemical exposure, adequate ventilation systems should be in place to remove hazardous fumes or particles from the air.

2. Administrative Controls:

- Provide adequate training: Regular training sessions should be conducted to educate machine operators and maintenance personnel about the potential hazards associated with the machine and how to use it safely.
- Develop and implement safe work procedures: Clear and detailed work procedures should be established, outlining safe operating practices, hazard controls, and emergency response protocols.
- Conduct regular maintenance and inspections: Scheduled maintenance and inspections should be performed on the machine to identify any potential faults or hazards and rectify them promptly.

3. Personal Protective Equipment (PPE):

- Provide appropriate PPE: Based on the identified hazardous exposures, workers should be provided with suitable PPE, such as safety goggles, gloves, hearing protection, or respiratory protection, to minimize the risk of injuries or illness.

Regular monitoring and evaluation of the effectiveness of the implemented control measures should be carried out to ensure continuous improvement in workplace safety and to prevent accidents or incidents.

CONCLUSION

The hazard identification and risk assessment for machines in a manufacturing industry is a critical process that helps ensure the safety and well-being of workers. By identifying potential hazards and assessing the associated risks, companies can implement necessary control measures to prevent accidents and injuries.

During the hazard identification process, it is important to consider all potential sources of danger, such as moving parts, electrical systems, and mechanical failures. This can be achieved through inspections, consultations with workers, and review of incident reports. By understanding the specific hazards posed by each machine, preventive measures can be implemented, such as guarding, lockout/tagout procedures, and safety training.

Risk assessment is then conducted to evaluate the likelihood and severity of potential accidents or injuries. This includes considering factors such as the frequency of machine use, the level of risk exposure for workers, and the effectiveness of existing control measures. Through this assessment, prioritization can be given to the most critical risks, allowing companies to allocate resources and implement appropriate risk control measures.

Overall, the hazard identification and risk assessment process is an ongoing One that requires regular review and updates as machines are added or modified. By proactively identifying and addressing potential hazards, companies can ensure a safe working environment for their employees and minimize the risk of accidents and injuries.

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