Identification And Mitigation Of Risk Associated With Eot Crane During Material Handling

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Identification And Mitigation Of Risk Associated With Eot Crane During Material Handling

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By

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Supervisor's Certificate

This is to certify that the works presented in this thesis entitled "*Identification And Mitigation Of Risk Associated With Eot Crane During Material Handling* " by "*Nitish Misra*', Roll Number 215ch2055, is a record of original work carried out by him under my supervision and guidance in partial fulfilment of the requirements of the degree of *Master of Technology* in *Safety Engineering* under the department of *Mechanical Engineering*. Neither this thesis nor any part of it has been submitted for any degree or diploma to any institute or university in India or abroad.

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Declaration of Originality

I, *Nitish Misra* Roll Number 215ch2055 hereby declare that this thesis entitled "*Identification And Mitigation Of Risk Associated With Eot Crane During Material Handling"* presents my original work carried out as a postgraduate student of NIT Rourkela and, to the best of my knowledge, it contains no material previously published or written by another person, nor any material presented for the award of any other degree or diploma of NIT Rourkela or any other institution. Any contribution made to this research by others, with whom I have worked at NIT Rourkela or elsewhere, is explicitly acknowledged in the dissertation. Works of other authors cited in this dissertation have been duly acknowledged under the section "Reference". I have also submitted my original work records to the scrutiny committee for evaluation of my dissertation.

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May , 2017

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May , 2017 *Nitish Misra*

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Abstract

Countless manufacturing and construction industry are widely used E.O.T. cranes for their lifting or loading materials from one place to another place, also associated with a large number of hazardous in their operation.depending upon their nature of work it can further divided on their different type of use.the hazard associated with E.O.T. crane a project was performed in tata steel processing and distribution limited(TSPDL), with the help of checklist method and hazard identification & risk assessment, is performed to identified the hazardous condition on 13 E.O.T. cranes installed in TSPDL and their control measures are given.with the help of hira analysis is reviewed and also recommendations are given for further improvement in safety and health aspects.this E.O.T. crane increase output and improves the quality of the product, speed up deliveries and therefore, results that decrease the production cost.

As an EHS professional must have sufficient knowledge of L.I.F.E and zero harm/zero injury vision along with inspiring others to behave safely and have due regard for the environment.He must have an ability to finding out the connection between good EHS system and good business practices and have up to date knowledge about EHS.He must have good communication skills to convenience to others and show a leadership skill to all levels of employees and committed to action at all times.

Risk assessment has four stages identifying hazards, access the risk, determine the control measures, and implement the control measures, review, and update.With the help of hierarchy control i.e. elimination, substitution, engineering control, administrative control, training and PPE's those risk assessment approaches are implemented successfully.

Keywords*: *EHS risk assessment; Data collection; Data analysis;Job Cycle Check;Lifting Equipment;Lost Time Injury;Corrective Action.

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Chapter 1

Introduction

1. Introduction

Material Handling is a main/primary input or component of any manufacturing industry.material handling is always active,dynamic and competitive.material handling system can be defined as"movement handling,storage and controlling of materrials throughout the manufacturing process".the main objective of material handling is to properly ensure that right amount of raw materials delivered carefully to the required destination at perfect time at minimum cost reduction.Though material handling is not a production process and hence management or higher authority of the industry does not add to the value of the product but it costs 30-75% of the total production cost.a properly sound material handling system ensures that the cost reduction cycle time,delay and manufacturing cycle time,delay and less damage in products.Material handling applies to the transfer of raw materials,part in process,finished goods,packaging materials and disposal of scraps from one place to another place.The several factors considerd when a material handling system is designed include

1. Form of material at point of origin e.g. liquid,granular,sheets etc.
2. Flow demands e.g. amount needed,timing etc.
3. Handling equipments aviable.

Other factors must be considerd as

a. Labour competency,
b. Available of capital

A crane is a mechanical lifting device which is equipped with a rope drum,wire rope and sheaves that can used to lift and lower materials and move the materials horizontally.E.O.T cranes are very famous in many indutries for lifting the safe working load.

In Tata Steel processing and Distribution limited(TSPDL) EOT crane is used to transport the mother coils,finish good packets,bins,equipments parts,and for maintenance purposes.the mechanism has a rope & drum assembly which is rotated by an AC MOTOR

and electric drives.there is a parking brake assembly attached with the motor to hold the load at desired postion.

Applications of material handling device like EOT crane is a main components in the construction industry for transfer of material from one site to another site,assembly of heavy engineering equipments in manufacturing sector,loading and unloading in transport sector etc.this material handling equipments increase the output rate,improve the quality and speed up the deliveries of product and therefore decreases the production and therefore decrease the production rate of the product.Increase in labour management the use of the equipment remain increased in each and every industry.

There are four bays in the TSPDL plant where the steel coils passes through different activites such as slitting,cut to length,corrugation and finally packaging.Through out the process line from reciving the mother coils to finish goods packaging and properly storing about ¾ th of total activity is related to material handling.the material handling activities are carried out with EOT crane,fork lift and transfer trolleys.

Among all these equipment EOT crane is mostly used material handling equiment along the bays transfer trolleys are used for transferring materials across one bay to another and for arranging the finish good packets.

My project is related to study and identify the hazards and suggest the corrective actions that may applicable to mitigate the risks arising from the existing hazards and to advice engineering solutions that may eliminate thses hazards.Equipments used for material handling in TSPDL plant

A. Electric over head travel crane(E.O.T)- 13 Nos
B. Forklift- 3 Nos

Rigging tools used in material handling

a. “C” hook
b. Metal Slings.

1.1. Objective Of Project:-

The main objective of the project is

1. To study and identify the hazards related to unsafe practices and recommended good and safiest practices related to material handling process by E.O.T crane.
2. To make material handling system more ergonomical and safe.
3. To mitigate material handling process related risks involved during material handling process.
4. This includes the requirements for ensuring that employees plant of are not placed at risk from the operation of the crane.

1.2. Selection Of Project:-

Selection reasons behind of the project:-

The reason for selection of the project is to improve the safety associated with material handling activity in TSPDL as

a. About ¾ th of total activity of TSPDL plant are related to material handling.
b. Maximum number of past incident/accident occured during material handling activity.
c. Maximum number of unsafe practices are observed during material handling activity.

1.3. Organization of the Project Report

This Thesis is organized in seven chapters of which this is the first. Chapter two deals with literature review. Chapter three comprises about EOT crane components and its hazard control measures. Chapter four describes EHS Risk assessment of EOT crane.In chapter plant visit and observation of the EOT crane activity. In chapter six describes results and graphs of the project.In Chapter seven concludes the report by summarizing the works done here and futher recommendation.

1.4. Project Highlights

Name of the work	:	Identification And Mitigation Of Risk Associated With Eot Crane During Material Handling Process.
Client	:	Tata Steel Processing And Distribution Limited (TSPDL)
Location	:	Jamshedpur,Jharkhand.
Scope of work	:	Identification And Mitigation Of Risk Associated In Material Handling Process With Eot Crane Activity.
Budgeted manpower required	:	300 Approx.

Fig 1.1. MATERIAL HANDLING WITH EOT CRANE USING "C" HOOK

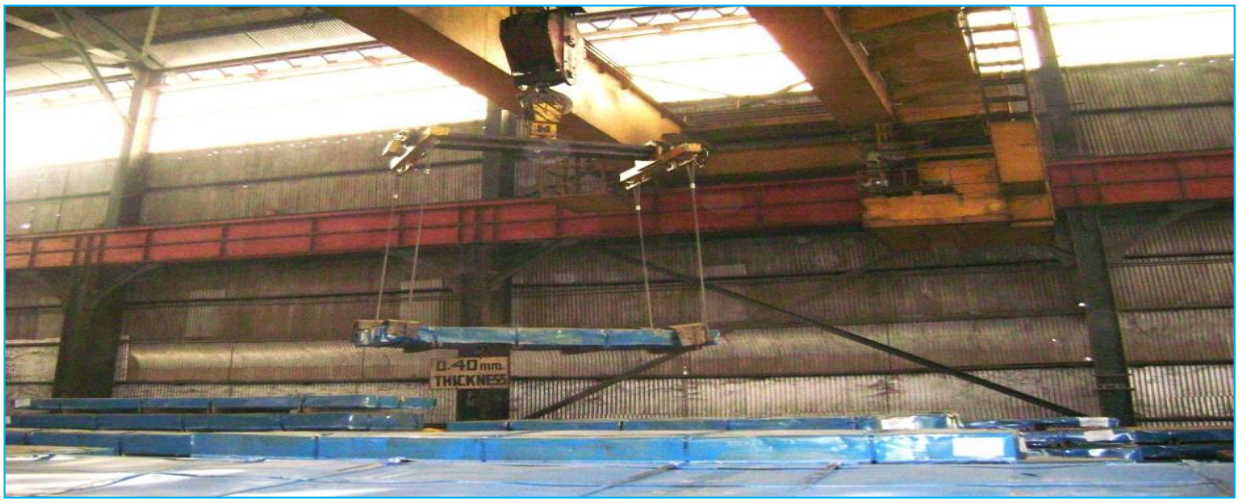

Fig 1.2. MATERIAL HANDLING WITH EOT CRANE USING SLINGS

1.5. A View Of Company(Tata Steel Processing & Distribution Ltd)

Fig 1.3. Tata Steel Processing and Distribution Limited Jamshedpur

1.5.1. Introduction About TSPDL:-

Our project was conducted in Tata Steel Processing and distribution Limited,one most trusted steel processing plant belong to the Tata group of company.It is the company where one can extract maximum satisfication of his work,where it is a regular proffesional work or academic project work.

Tata steel processing and distribution limited incorporated in the year 1997-98,in the business of processing & distribution of steel.it having 8 plants and 21 distribution location across India.The main process of the plant is slitting,pickling,cut to length and corrugation.

Product offerings:- HR & CR slit coils,HR & CR sheets,GC sheets,C&B Rebar,CRF component,BTS plates.

OHS policy:- TSPDL is commited to creating and maintaing an environment where management and staff shall work in harmony to ensure a safe and healthy workplace for all employees,contract workplace,visitors and third parties by continuous improvement and ensuring action for prevention of loss time accident under and guiding principle of occupational health and safety management system and complying with all applicable laws and regulations.

TSPDL seeks to achieve excellence in occupational health and safety performance through continuous improvement inititiatives driven by regular reviews and adopting best practices.

1.5.2. Objectives of TSPDL:-

- TSPDL shall adopt and implement all applicable rules and regulations and good industry practices relevant to the steel service industry.
- TSPDL shall purchase materials and saervices that meet relevant safety norms.
- TSPDL shall communicate to all employees and stack holders on all occupational health and safety aspects and motivate them for active participation.

1.5.3. Safety Vision Of TSPDL:-

TSPDL will pursue excellence in safety safe behaviour,upgrading standards and practices to achive Zero lost time injury(LTI) by 2020.

Chapter 2

Literature Review

2.1. Review

[1] (2001) he gives a brief description about crane safety in industry and in this paper also discussed collecting data on crane-related injuries, currently, safety devices and crane safety standards operating procedures.recommendations how to improved crane injury prevention and future aspect of research work on crane safety.

[1] (1953) Bramley discussed first ideas for ergonomic consideration of crane cabin design ideas come from original and common sense.he also observed that the main varied control function of the crane is design, function, and manipulation.

[2] (1999)das & sen conduct a study about ergonomics studies on machine control, movement of cabins and 51 C-hook in electric overhead traveling cranes in a big industry .he also observed that control movement compatibility in absent in most of the cranes and gives a low-cost ergonomics solution recommended to control these problems.

[3] Tor-olav nvestad richard(2007) this paper gives ideas about an account of two typical way of understanding by the process operators and crane operators on Norwegian offshore platform in the north sea as they interpret, negotiate and defined various hazardous situations.

In this distortion discussed definitions of situations as dangerous after the experiment, it is concluded that different work process of the workgroups seems and observed different hazards, way of innovation and reduce hazards.

[4] Yogi raval in"Design analysis and improvement of EOT crane" analytical study on how to optimize the size of the crane wheel.

[5] Abhinay suratkar and vishal shukla "3 D modeling and Finite element analysis of EOT crane" made a difference between analytical calculations and finite element analysis.

[6] Patil P. And nirav K. In"Design and analysis of major components of 120 T capacity of EOT crane" analyzed various components of EOT crane e.g. pulleys, rope, drum, girder and wheels etc.By using Indian standard they have done manual calculations.

[7] In IS:4137-1985 various factors to be maintained for further design of crane components.

[8] In IS:807[2006] various design parameters e.g. design, erection, and testing of crane and hoist are mentioned.

[9] In IS:3177-1999 various factors like drive efficiency average accleration,friction factors for anti-friction bearing are mentioned.

[10] J.S.Noble and C.M.Klein ,A.Mid ha have examined the different way of integrated material flow system its design problem.They construct or develop a model which integrates different material handling equipment selection and its specification, and load, load size etc.meta-heuristic procedure is formulation to solved a good solution to a more integrated formulation.

[11] Ramzan YAMAN develops a knowledge-based system material handling selection and pre-design of these types of equipment in the layout is discussed in that position.two sections divided in that study, in first section author explained about the particular selection of material handling equipment and in the second section decision making for types of equipment between various dept.it gives a clear idea about right method to provide the right amount of material at right time.

[12] J.D.Tew,S.Manivannan,D.A.Sadowski, and A.F.Selia used the simulation methodologies used in the design of automated material handling system(AMHS) at intel wafer fabs for semiconductor manufacturing.AMHS models support the design of Interbay and Interbay system.In AMHS approaches production models use a consistent set of assumptions.

[13] Prasad Karande and Shankar Chakraborty have carried out the selection method for suitable material handling equipment.Multicriteria decision making(MCDM) tools are used.

[15]S.X. Jeng et al.(S.X. Zeng 2008) argued in the favor of an integrated standard to deal with safety issue. By integrating ISO 9001, ISO 14001 and the OHSAS 18001, chance of delicacy and resource to implement along national standard will be reduced.

[16] Cox et al.(2008) figure out the ambiguous input and output of existing risk matrix so it must be used with ample experience and a good sense of judgement.

[17] David et al.(2011) developed a 4 × 4 matrix for pre job hazard analysis. He divided the risk level into 4 categories and specifies the requirement for each risk band to minimize the risk. The activity falls under risk level one basic craft skill is sufficient on job site, for second level hazard awareness expertise required on job site, for third risk level competent person required on job site and for fourth risk level expert required on job site.

2.2. Problem Statement

Project work has been done in four steps. First attempt is to understand every step for steel processing i.e. slitting,cut to length,corruguration,loading & unloading of coils and sheets etc.second step is to develop a risk analysis is matrix and job cycle check(JCC) as per EHS standard at TSPDL.Third step is EHS risk assesment and job cycle check done by matrix method for every crane handling activities.Then gap analysis is done by data collection from different dept,data analysis,employee survey,evaluate finding gap between collected data and my project work data.last stage is suggest for improvement.

Chapter 3

E.O.T Crane Components & Hazard Control Measures And Survey

3.1.Basic components of E.O.T crane:-

3.1.1. Girders- variation of span and capacity crane girders of different designs are in some common use.Most popular design of girders are wide flange beams,capped structrual beams,box girders and lattice girders.

Due to design efficiency of box girders it is most popular used.box type girders made of structural steel plate.Full depth stiffeness and additional partial depth stiffenses.contribute to the internal strength of the girders.

These girders take the vertical load and deflection within the permissible limit.

3.1.2. End carriage:- Both sides of the girders end carriage are located.they house the wheels on which the entire travels.Mainly its consists of structural members,wheels,bearings,axles to provide the support the bridge.

3.1.3. Hoist Machinery:-Assembly of motor ,gearbox,breake,coupling,drum,wire rope and bottom block hoist mechanism is constructed.hook block is suspended from drum through wire rope.The main measurement components which should be considered when selecting a wire rope is(a)lifting load, (b)rope falls number.

3.1.4. Long travel machinery:- the main unit to construct a long travel machinary is motor drive,coupling,brakes,gearing & wheels which may be travel on both direction.

3.2. Selection of E.O.T Crane:-

3.2.1. **Based on safe working load:-**Double girders cranes can lifts upto 500 T load capacity.For low safe working load single girders are more suitable.due to extra girders in double girders cranes can carry safer working load than single girders cranes.

3.2.2. **Based on span:-** In case of smaller span single girder crane are usesd and for longer span double girder crane are used.

3.2.3. **Based on application:-** Single girder cranes are used for irregular and light use e.g. workshops ,stoprage area etc.Doble girders are efficients for extreme condition like lifting the molten metal.

3.2.4. **Based on cost:-**Singlr girder cranes are less costly than double girder cranes.

3.3. Eot Activity Flow Sheet:-

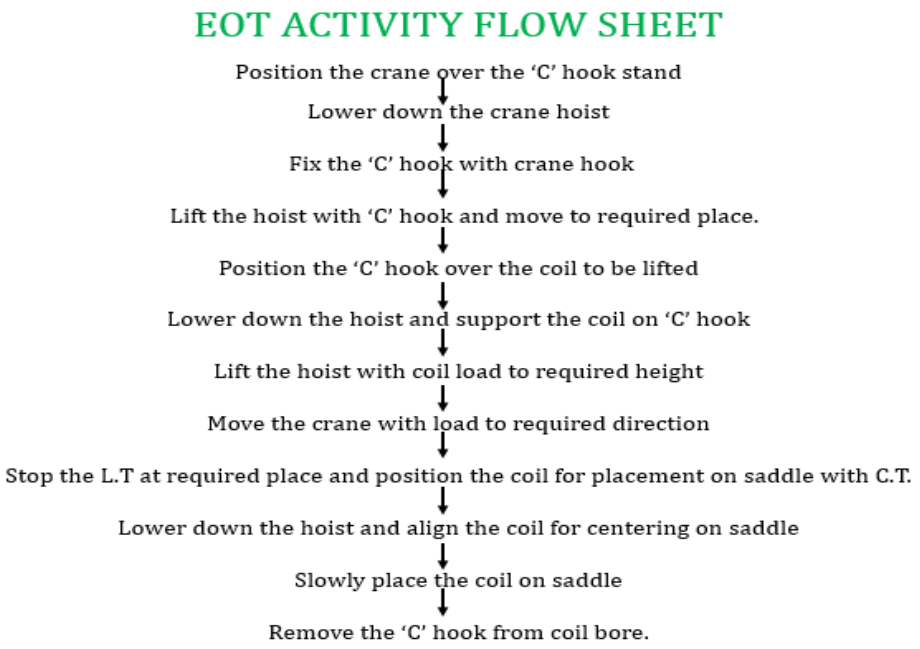

Fig 3.1. EOT flow sheet

3.4. E.O.T. Safety And Major Hazards And Preventive Measures:-

Countless manufacturing and construction companies used overhead cranes to lift and transport materials from raw material handling department to required department.when properly installed and used properly, these E.O.T crane system makes operations easier and safer.but, E.O.T crane accidents cause severe injuries and accidents each and every year.control those hazards workers to recognize certain hazards that occurred during crane operation and follow proper safety measures to control accident rates.

There are multiple hazards that can arise regarding crane operation in general.analysis of overhead crane accidents three common safety hazards that every company using overhead lift system should special care was taken and take proper action on it to keep their workers safe.these three most common hazards involving E.O.T crane activity like electrical hazards, overloading, and material falling.

It is the responsibility of crane operator and supervisor to ensure that crane operators are special qualified and competent.

3.4.1. Electrical hazards:-

According to OSHA, nearly 50% of EOT crane accidents are result of machinery coming into contact with electrical power source during crane opertaion.most of the cases powerline contact with crane during moving materials nearby or under energized powerline,and hoists or boom touch one of them.generally the person who is electrocuted in touching the crane,but the danger is not just limited to the crane operator,it extends to all personnel in the vicinity.

A single contact with electric powerline can result from multiple numbers of injuries and fatal.each year near about 200 people die from powerline contact and more than 600 persons are seriously injured.

Planning is one of the famous and biggest decision-making tools to prevent that type of accidents.To start the job, it is very important to establish Tool Box Talk before a start of the job.always cranes should keep away from unsafe areas.according to OSHA and ANSI both gives a guideline that operator must maintain a safe distance from a power source when working at a job site.crane operator should well known about all potential danger zones, which are referred to more hazardous.within 10 feer radii of powerline should consider as danger areas.there should be a visual display board to ensure that cranes are always positioned at out of danger zone.

Overall it is very important for workers and operators to provide training to avoid danger zones where electrocution can occur.initially confirm that ladders, tools, and system are non-destructive and ask the electric department to ensure that properly earthing of the powerlines or total connection is connect with MCV.

3.4.2. **Overloading: -**

According to OSHA 80% of crane upsets and structural failures can occur due to exceeding the crane operational load capacity.when the crane is overloaded,It is subjected to the structural stress of the crane and that may cause damage of the crane.The main cause of overloading are swinging or sudden dropping of the load, using defective components, hoisting a load beyond its capacity.

According to OSHA observed that for every 10,000 hours of crane use, a crane may upsets.nearly 80% of these upsets occur due to human error when crane operator inadvertently exceeds the crane capacity.When poor skilled or un-trained personnel are allowed to operate the crane overloading may occur.sometimes found that operators over confident about themselves to carrying out heavy load beyond its capable capacity.the load can be measure by different new technology.

Always load capacity board should be displayed on that crane operating premises.In TSPDL every EOT crane side walls are displayed its load capacity operator always maintain beyond its permissible limits.

The operator must be well trained and clear understanding of load dynamics, lifting capacities and the condition under which such lifting capacities are valid.

3.4.3. Material Falling:-

Material falling is the major concern at the workplace where using E.O.T cranes.If materials are not properly tightened by hooks, the load can slip and load on workers in that area or cause major injuries.one way to reduce the risk of falling material is to perform regular basis is a maintenance of hoists, load testing maintenance should be treated seriously.If a moving part on an overloaded crane wears out or breaks the hoists, it may cause serious injury or property damage.

Improper securing of the load or the slings which carry the load that loading causes of accidents with overload hoists and cranes.Before the start of the crane, job operator should inspect every part of the crane carefully.During maintenance time of crane, an operator should use LOTO(lock out & Tag out) to prevent any type of accident.

An employee working around cranes should always wear proper PPE's(Personnel Protective Equipment) e.g. head, foot, hand and eye protection.when moving material operator should never rise the load higher than required clearance.

Installing "hoist danger" signboard display around that crane moving area that will help to alert other employees that an EOT crane is operating over their heads.In TSPDL plant when EOT crane moves from one place to another then some sound is used to alert their employees("Sabdhan crane Chal Raha hein" in English "crane is moving be attention to all employees").

Operators and controllers must maintain 100% focus on the task to avoid any dangerous occurrence.

3.5. Findings EOT Crane related Hazards At Tspdl Plant

3.5.1. Physical Hazard:-

1) During travelling of EOT cranes no hooters and light signals observed in most of the EOT cranes.
2) Rolling of crane During loading/ unloading of coil.
3) Uncontrolled lowering of loads.
4) No safety device to avoid the collision of EOTs.
5) All electrical panels are unprotected and exposed. The panels vibrates violently at the time of crane movement.
6) All hand railings over the crane are not of adequate strength in most of the crane.

7)The entrance to the operators cabin is un protected from power rail.

3.5.2. Process Hazards:-

1) Placing coils on the floor with out wooden scotch or saddle.
2) At the time of loading / unloading of coils or Finish goods are generally done by using wire rope slings and felt pads are used for protection of the goods packets edges, there may be a chance of trapping fingers while fixing the edge protectors.
3) Movement of EOTs with hanging loads are usually unprotected for the persons standing or moving below the hanging loads may get injury by falling of loads due to failure of "C" hooks or slings.

3.5.3. Ergonomical Hazards:-

1) At the time of loading of coils on the trailer/ truck helpers generally stands on the trucks holding the "C' hook handle.
2) Positioning and directing the "C" hooks to insert in to the coil bore is usually done manually by pulling.
3) The crane operators moves the hanging loads over the equipments and the F.G.
4) Some times it is observed that the helper is engaged in some other activity and the crane operator alone is doing the load carrying activity with EOTs.

Table 3.1. shows the hazard identified in an E.O.T crane along with their control measures taken against various hazards.

Table:-3.1. Different type of Crane Hazard & Control Measure

Serial Number	Hazard Identification	Hazard Control
1.	Equipment or control failure	➢ Check all controls are functioning correctly before proceeding. ➢ Do not exceed SWL. ➢ Remotes must be checked against specific cranes.
2.	Crushing	Ensure work area is clear .
3.	Unexpected movement	➢ Emergency procedures should be in place in case of load movement. ➢ Position slings correctly and check load balance, lower and resling if not balanced.
4.	Incorrect Stacking of materials	Ensure all materials are stacked in a stable Condition.
5.	Slinging	➢ Only qualified persons use sling for correct load. ➢ Taking color code, load weight and sling angles.
6.	Pedestrian / Employee interface	➢ Be aware of pedestrians walk way. ➢ Nobody allow to walk under suspended loads.
7.	Obstructed view	➢ Do not lift any loads if you can not see others in that areas, ask for a competent person to give clear verbal communication and physical instructions for lifting the load.

8.	Operating personnel haven't received professional training.	➢ Those who operate cranes should be professionally trained and competent who get a qualification certificate. ➢ Operate cranes under the supervision of skillful competent operator.
9.	Working aloft	➢ Equipment followed as per required indian standard.Don't Operate without safety belts. ➢ Put the hook on the ground instead of lifting load with hook when needs some emergency maintenance.
10.	Operating at night/ illumination at site	➢ increase illumination. ➢ Don;t operate cranes at illumination or insufficient light.
11.	Grease pollution	➢ Hoisting equipment should be placed at fixed point. ➢ Donot operate cranes at greassy or oily floor.
12.	Carrying inflammable, explosive,Toxic and other dangerous goods	Take special technical safety measures approved by Safety Dept or Shift in-charge.
13.	Hydraulic crane's maintenance	➢ Floor should be clean properly after crane maintenance because after maintenance floor should be greasey. ➢ Operators should adequate knowledge about crane performance.

Chapter 4

Methodology

4.1. Risk Assessment Of E.O.T Crane:-

Risk can be defined as a situation involving exposure to danger.Risk assessment is a systematic analysis of any job, activity or process that perform for the determination of;

- Identifying the hazards that existing hazard at each activity.
- Deciding whether any control measures are already taken or not for reduce the risk to an acceptable level.
- Deciding what further control measures take to reduce the risk to an acceptable level of risk .

Risk Assessments should also be done to satisfy the requirements of law but more than that to make sure the Safety & Health aspects of employee.

4.1.1. Procedure for Risk Assessment

4.1.1.1. Activities to be considered

Risk Assessment shall be done for

- Routine & Non routine wise activities.
- Activities of all peoples in the workplace (including visitors, contractors and subcontractors).
- All facilities within the workplace.

4.1.1.2. Input for Risk Assessment

The input for conducting the EHS Risk Assessment shall include

- All Work activities
- Machineries and tools using for work
- Record keeping from past incidents
- Relevant legislations, codes, rules and specifications
- Full details of present control measures

- Feedback from clients, staff, suppliers, interested parties
- Other information such as MSDS(Material Safety Data Sheet), Instruction manual,user guide manual.
- Previous risk assessments reports

The following points shall be considered while identifying Health & Safety Hazards, Environmental Aspects:

- ❖ Hazards initiating outside the workplace.
- ❖ Environmental aspects created in the surrounding area of the workplace
- ❖ Human behaviour, competencies and other human factors.
- ❖ Infrastructure, materials and equipment at the work site.
- ❖ Amendments to the Environment health and safety system, including temporary changes.
- ❖ All design aspect of work site.

4.1.1.3. Evaluation of Health, Safety, and Environment Risk Impact level

The evaluation shall be done by

- ❖ Identifying the existing risk control measures;
- ❖ Determining the likelihood of occurrence or probability ;
- ❖ Assessing the potential severity of the health & safety hazards, environmental aspects;
- ❖ Ascertain the risk / impact level based on the Probablity,Exposure and Consequence.

Steps Of Risk Assessment

4.2. Risk management process

EHS Risk management process has five step.(1)Identify Hazards(2)evaluate the risk / impact(3)determining controls(4)Implement the controls(5)Review and update

4.2.1. Idenify hazards:- This step involves the identification of hazards which is associated with the activity.in this step also source of risk and consequence, exposure is determined, this determination leads to an adverse effect on the project work.The main point shall be taken into account when identifying hazards like health, safety, and environmental aspects are activities of all person access to workplace, human behaviour with human factor, man and machine relation with ergonomics ,hazards originally from outside but affecting the health and safety of persons under that vicinity,changes or propose to changes within the organization and can be extended to its activities and materials ,remodification of EHS system including temporary changes and their impact on activities.

Risk analysis: - In this stage evaluation of risk is selected.One risk can have multiple consequence on the environment, health and safety aspects.our aim to eliminate of risk as lower as possible by using different control measures i.e. Administrative control, PPE's, Engineering control, substitution, elimination.

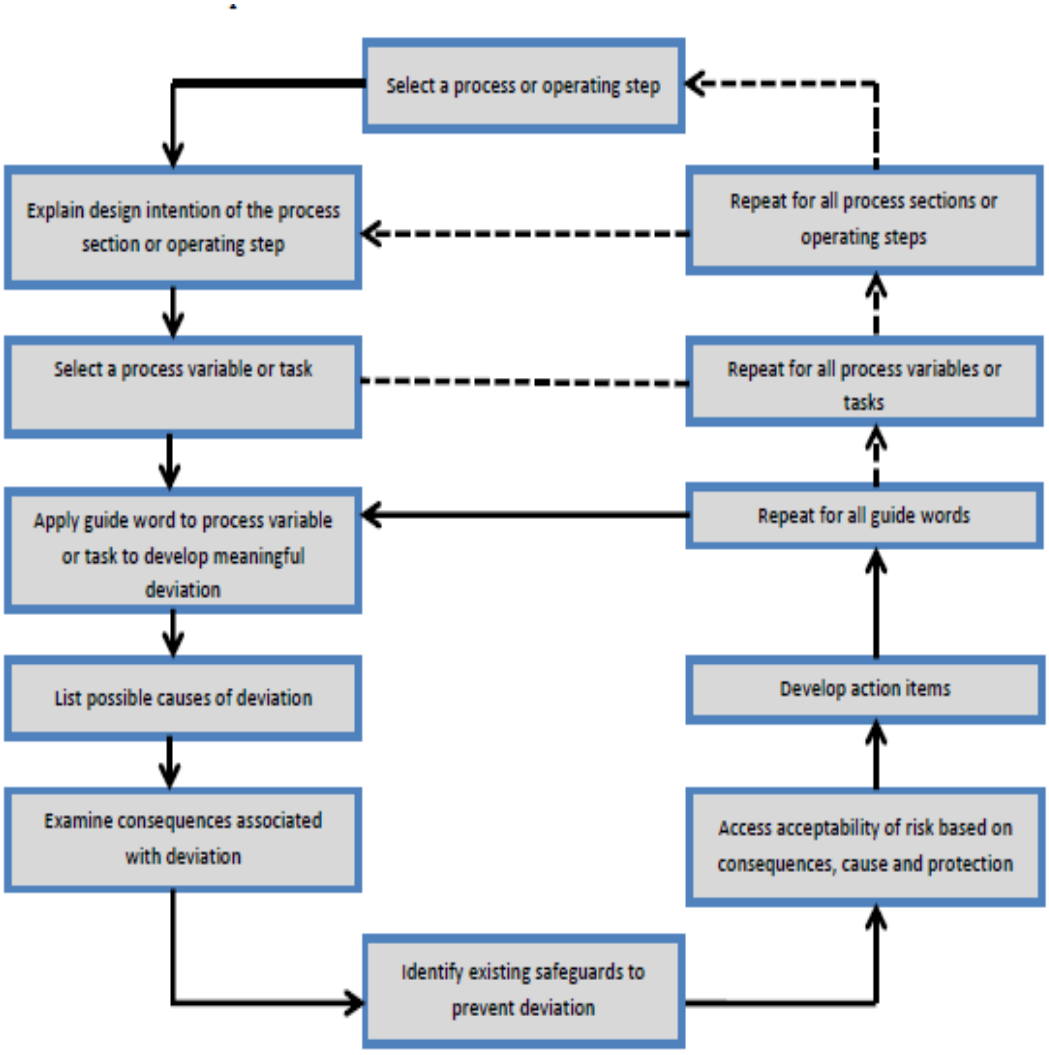

Fig.4.1. Hazard and Operability

4.2.2. Evaluate the risk / impact The risk evaluation shall be done by listing out,the existing risk control measures, the likelihood of occurrence (probability), assessing the potential exposure of the health & safety hazards, environmental aspects and ascertaining the risk / impact level based on the probablity,exposure and consequence.

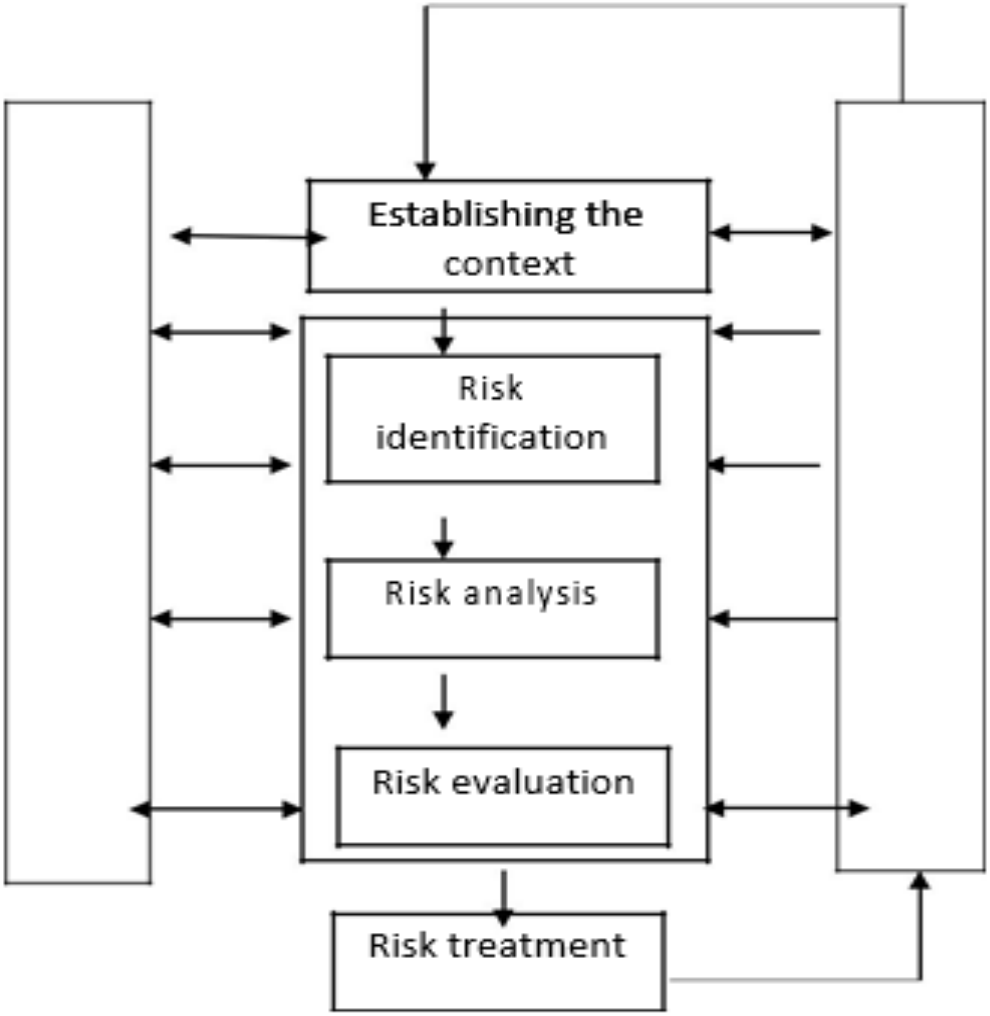

Fig 4.2. Risk treatment Diagram

4.2.2.1. Consequence(C):- It is defined as a result or effect, typically one that is unwelcome or unpleasant.

Table 4.1. Score Card Of Consequence

CONSEQUENCE(C)	CONSEQUENCE SCORE
Numerous fatality	100
Multiple fatality	50
Fatalities	25
Serious injury	15
First Aid	05
Medical case	01

4.2.2.2. Exposure(E):- It is defined as the state of having no protection from something harmful.

Table 4.2. Score Card Of Exposure

EXPOSURE(E)	EXPOSURE SCORE
Continuous	10
Frequent	06
Occasional	03
Infrequent	02
Rare	01
Very rare	0.5

4.2.2.3. Probability(P):- Probablity can be defined as a probable or the most probable event.

Table 4.3. Score Card Of Probability

PROBABILITY(P)	PROBABILITY SCORE
Almost Possible	10
Quite possible	06
Unusual but possible	03
Remotely possible	01

Very Unlikely	0.5
Practically impossible	0.1

4.2.3. Determine controls based on Risk level:-

Based on the risk level are determined, control measure should be selected to reduce it to acceptable level. This can be done by reducing the Consequence,Exposure and Probablity.

Risk can be measure by product of Consequence,Exposure and Probablity.In the below table 4.4. denotes all range of risk score and its preventive control measures.

RISK=CONSEQUENCE*EXPOSURE*PROBABLITY

Table 4.4. Risk Classification Based On HIRA

Risk Level(C*E*P)	Action & Time Scale
1. Very high risk(VH>400)	Work should not be started or continued untill the risk has been totally removed.If it is not possible to eliminate risk even with unlimited resources,work has to remain prohibited.
2. High risk(H)[200-400]	After the risk, elemenation process work should be carried out.Considerable measures should be allocated to control the risk.Where those risk involving work in progress, immediate control measures should be introduced.
3. Substantial Risk(S)[80-200]	Efforts should be made to reduce the risk,but the costs of prevention risks should be carefully measured and limited.
4. Moderate Risk(M) [20-80]	No extra controls are taken that may be given more consideration to a more cost, cost cutting solution or improvement that imposes no extra cost.Monitoring is

	required to ensure that control measures are implemented.
5. Probably Acceptable Risk(A)[<20]	No serious action is required and no documentary records need to be kept.

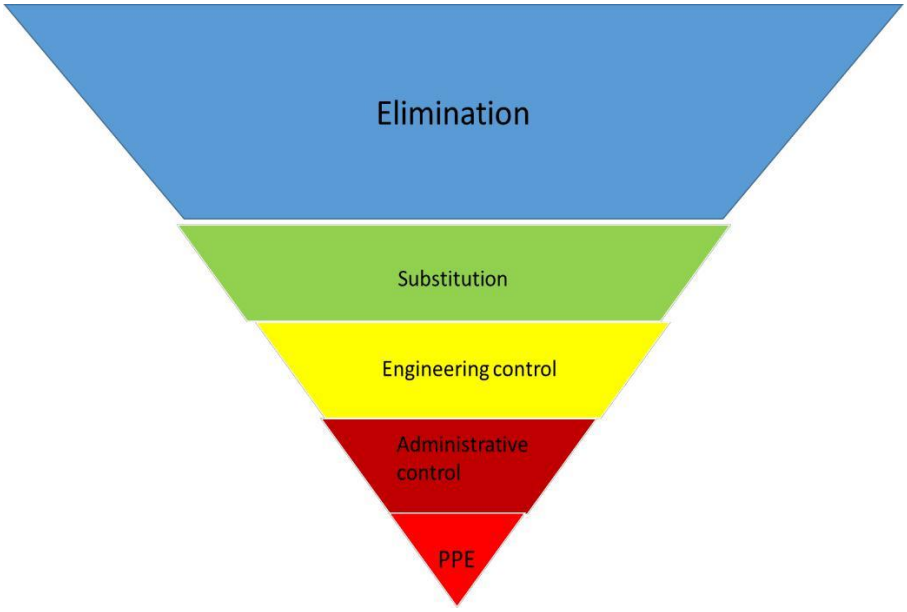

Fig 4.3. Hierarchy of controls

4.2.4. Implement controls

Work shall be carried out as per standard safe operating method. Adequate resource provide to ensured by authority to implement the controls measures taken successfully.

4.2.4.1. Safe Work Permit System(SWPS)

Safe Work permit systems shall be applicable for the activities which are required to be performed under controlled environment("IMS Manual," 2014) . The work permits shall be applicable for all of those activity likes working at height, confined Space work, hot work, work on Plant & Machinery and electrical work.

4.2.4.2. Daily Pre-start verification and Briefing to workmen

The Engineer In charge shall complete the 'Daily Pre-start verification and Briefing sheet' or pre start safety review (PSSR) before starting the work every day. 'Pre-start verification' ensures that the EHS risks involved in the day's task are assessed and site condition verified for compliance in line with the Risk Assessment and SWP. Before starting the day's work, the workers shall be adequate knowledge about the nature of the risks involved in that activity and the control measures implemented in line with the Risk Assessment and Safe work method statement. Language of briefing shall be understandable to the workforce.In TSPDL plant most of the workers are known about Hindi Language so During PSSR meeting authority discussed in Hindi language.

4.2.5. Review & update

Engineer In charge and Project EHS In charge shall conduct periodic inspections to verify the implementation of controls stipulated in the Safe Work Permit(SWP) method statement.

The EHS risk management system shall be reviewed periodically taking into consideration of field audit findings, incident reports collecting from workers and feedback from projects. The EHS Risk Assessment shall be maintained up to date.

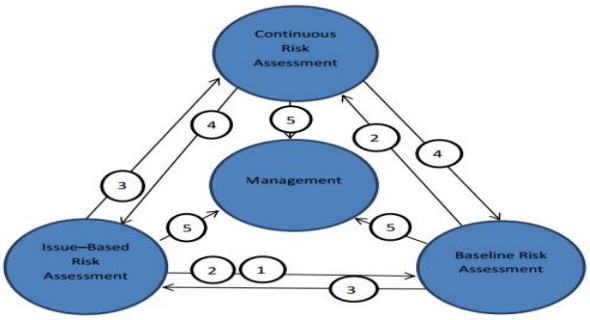

Fig 4.4. The Inter relationship between different types of HIRA

Chapter 5

Plant Visit And Observation Of The Eot Activity

5.1. Activity:-Loading and unloading of coil using with “C” hook

Present Work Practice :- ‘C’ hook inserting into the coil bore is done manually and which hangs freely from crane hook. Often it is observed that at the time of final lifting some portion of “c’’ hook arm moves out from coil bore. Particularly for bigger width coil complete inserting of “C” hook arm is very essential.

Fig. 5.1. Inserting “C” hook into coil bore

Fig 5.2.Handling coil with incomplete inserting of "C" hook arm

Suggested Method:-Our suggestion is to fix a sensor at the inner end of the "C" hook which will sense the complete inserting of "C" hook arm into coil bore. Only After the coil is supported and correctly inserted the "C" hook into coil bore the sensor will sense the hoist motor to start lifting.

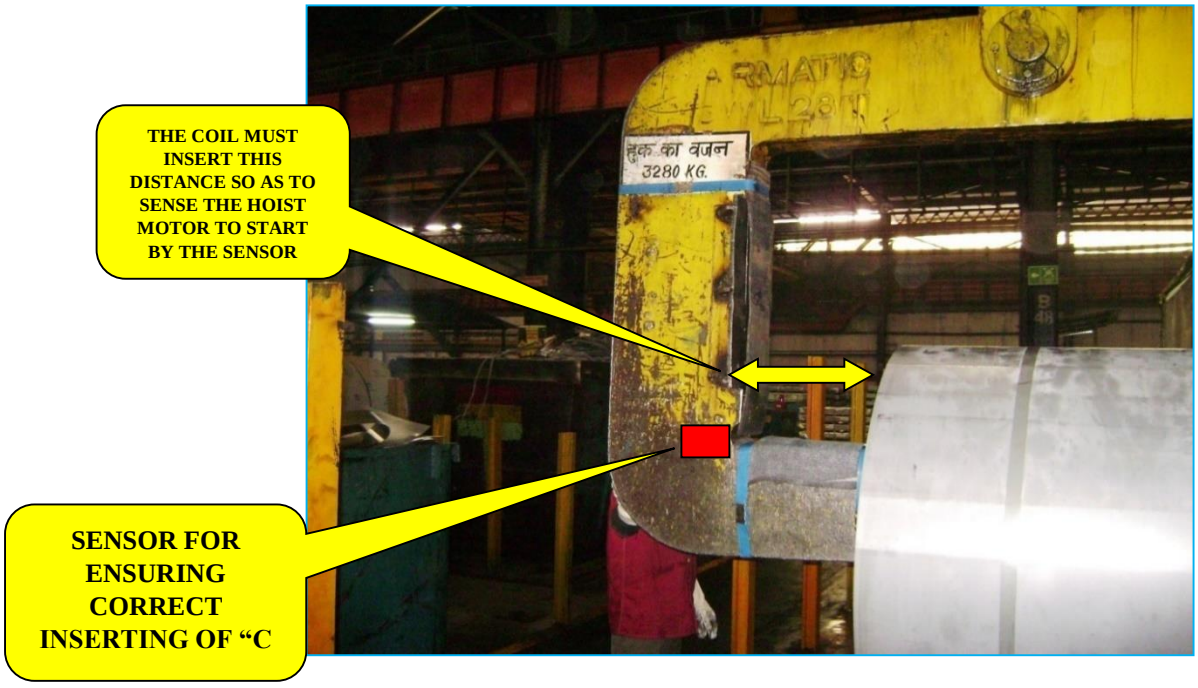

Fig 5.3. Suggest Figure of handling coil with complete inerting of "C" hook

Conclusion:-

- There should be some mechanism to ensure the correct inserting of "C'' hook.
- The operator must insure the complete inserting before final lifting of coil with "C" hook and it must be mentioned in SSOP. Operator should be given adequate training to follow this strictly.
- Visual display and OPL (One Point Lesson) must be provided all over the handling area.

5.2. Activity:- Centering and placement of coil on saddle

Present Work Practice - The placement and centering of coil on the saddle by EOT crane is done by operators estimation. It is some times over looked during mass production or pick time. For coil of smaller width, centering on saddle is not so difficult. For coil of width more than the width of the saddle, correct centering is necessary to avoid dislodging and toppling of coil from saddle.

Fig 5.4. Storage pattern of coil on the saddle

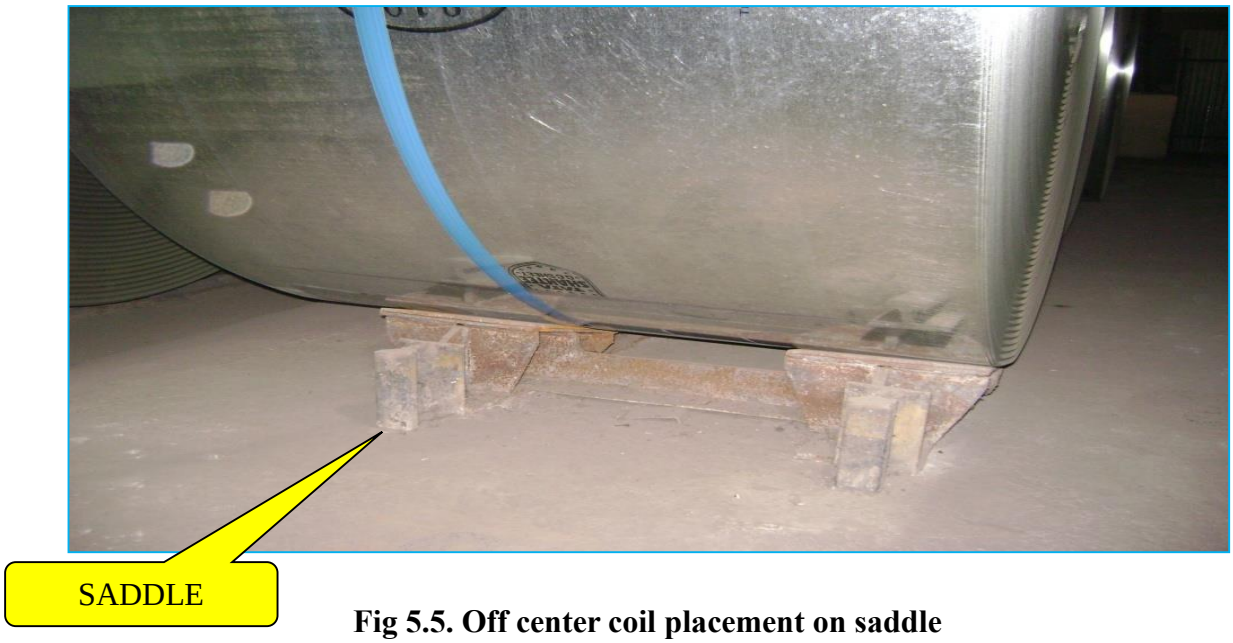

Fig 5.5. Off center coil placement on saddle

Suggested Method:- Our suggestion the correct centering of coil on the saddle may be guided by laser centering device fitted at the C.T. The laser beam will match the point marked on the floor near the saddle (Measured and pointed previously) that will indicate the accurate centering of coil on the saddle. There will no requirement of human estimation for centering.

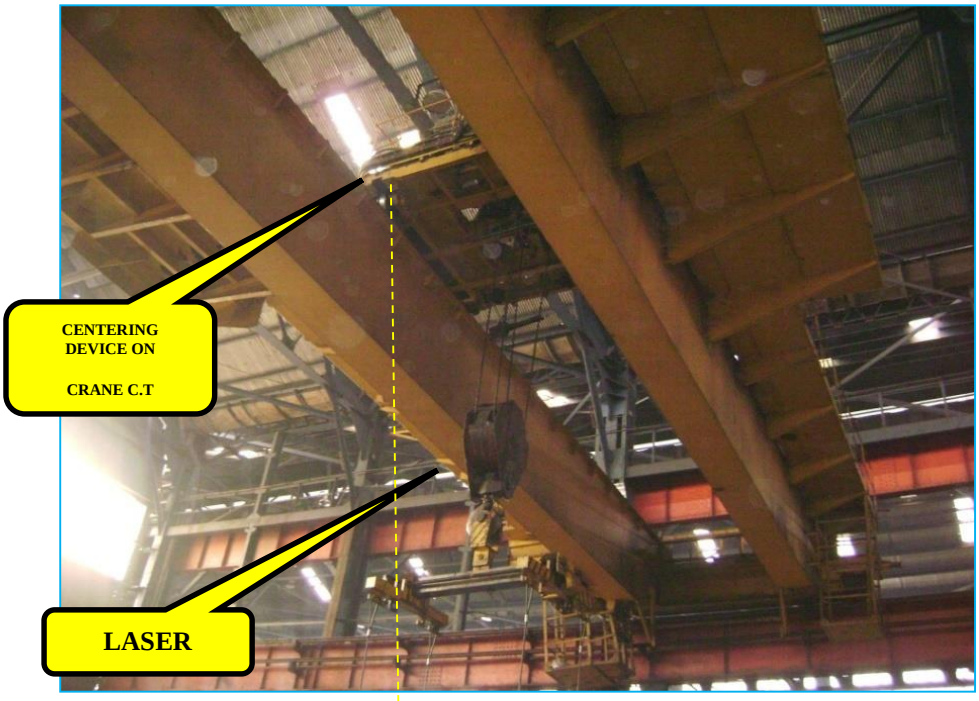

Fig 5.6. Laser Beam Emmiting From Centering Device Fitted On Cross Travel Of Eot Crane.

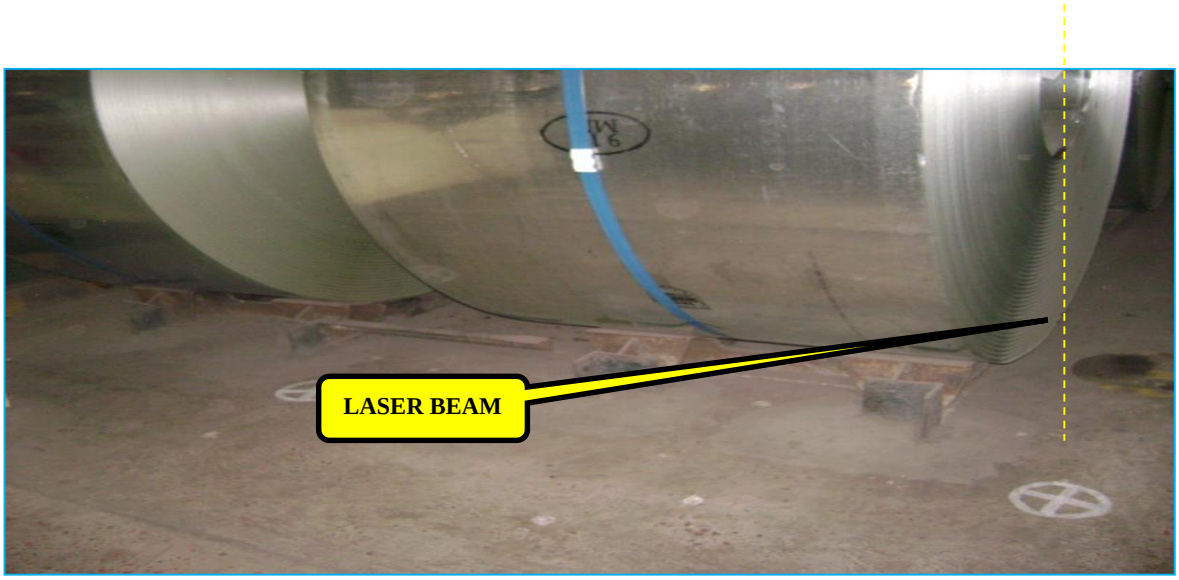

Fig 5.7. Laser Beam Falling On Mark Indicating Correct Centering Of Coil On The Saddle

Conclusion:-

(1)There should be some mechanism/sensor device which will indicate automatically accurate centering of crane hook/ load over the saddle

(2)The storage area where coils are stored on the saddle row the illumination must be improved in those areas.

(3)The saddle foundation and the fiber pads of saddle must have the routine checking and maintenance.

5.3. Activity:-Movement of EOTs with load

Present Work Practice:- EOT moves with load on crane gantry where other EOTs are also engaged near by in some activity. There is always a chance of collision between EOTs. The existing condition of electrical circuit is not adequate for precision control of L.T. Some times the L.T. does not stops due to malfunctioning of electric contractor or operators error. Uncontrolled travelling may also caused due to sagging of track rail of crane gantry.

Fig 5.8. Two Working Eots Working Very Close On Same Ganrty

Suggested Method:- Our suggestion is all the EOTs may be equipped with the anti collision device which consists of a laser sensor which will read any obstruction on the track rail on the crane gantry. The sensor will cut off the power of L.T. at a safe distance in case of L.T. brake contractor stuck up. There should be a provision to by pass the sensor from the control desk to meet the requirement.

Fig 5.9.Laser Sensor Of Anti Collision Equipment

Fig 5.10.Anticollision Device Fitted On An

Referance:- The horizontal deployment of idea from SCP machine of Coke plant.

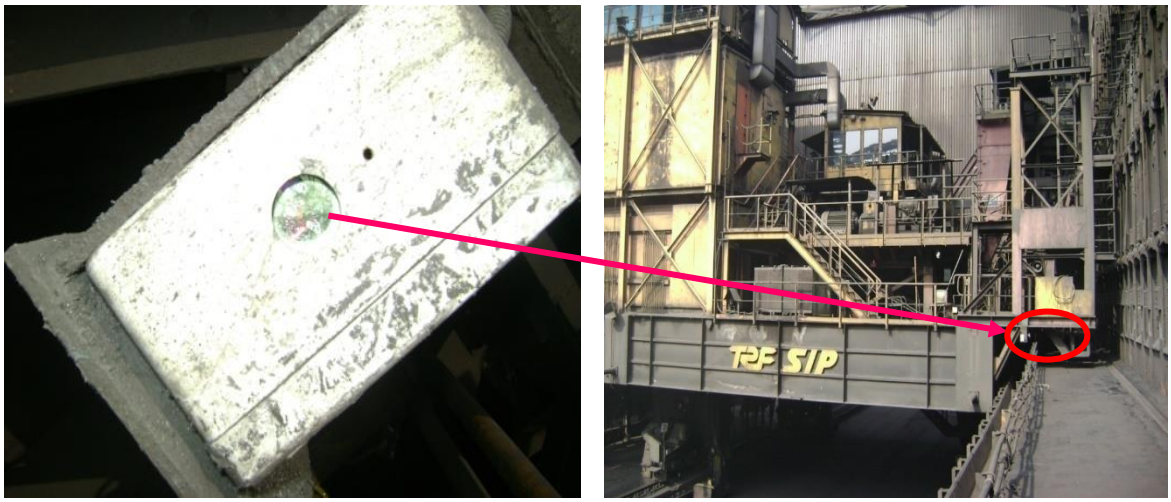

Fig 5.11.Reference Figure from The horizontal deployment of idea from SCP machine of Coke plan

The device consists of laser beam emitter and a receiver which measures the distance of the obstruction and produces the signal to PLC and cut off the power. The device having two settings one for slow down and next for cut off the power of long travel drive (10 mtrs for slow down and 6 mtrs for stopping L.T).

For using this in EOT crane there should be the provision of by passing the device from control desk, in case the close movement of EOTs are required in emergency.

Conclusion:-

- There may be some automatic anti collision device for prevention of undesired close movement of EOTs.
- A schedule should be made for checking the condition and the alignment of crane track. There must be a schedule of P.M. for changing the track rail at least twice in year.

5.4. Activity:-lowering of hoist with load

Present Work Practice:-Often it is observed that the at the time of lowering of loads the hoist motor starts but can not be stopped at desired time because of the many reasons such as electrical failure, other human error. As a result the load falls uncontrolled. It may cause serious injury or even fatality, spoiling of goods, equipments.

Hoist Assembly Photo:-

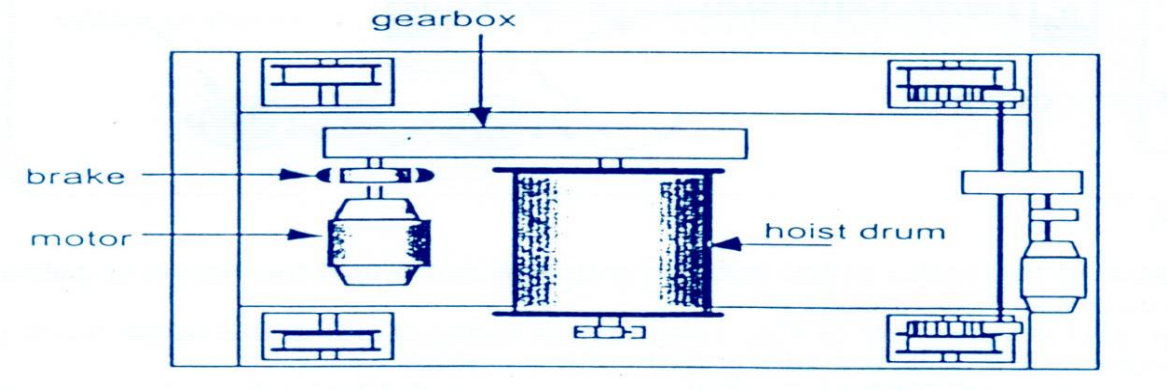

Fig 5.12. Hoist Assembly

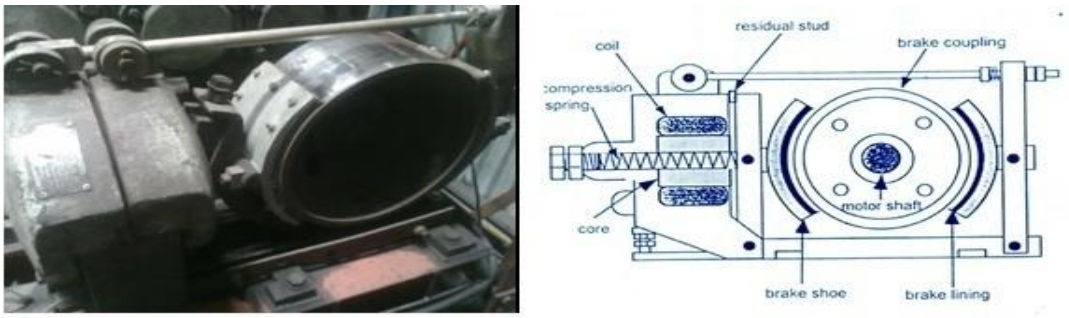

Fig 5.13. Hoist Brake Arrangement

Many free-fall incidences have occurred in TSPDL CR plant. One of the most predominant reasons is the brake contactor getting stuck-up. Any undesirable opening (brake opening without up or down command) of hoist brake will lead to free fall of load. The effect of free-fall is loss of production, property damage, injury which can extend up to fatality.

Suggested Method:- To provide an Automatic protection circuit to prevent free-fall which automatically detect the malfunctioning (Stuck-up) of the brake contractor.

Feature of the Protection circuit:

- In-house development.
- Plug & play type installation.
- Very easy to connect.
- Can be used in any existing crane hoist circuit.
- Can indicate the fault occurrence.

Referance:- The horizontal deployment of the idea is from CRM Over head cranes. Where after numbers of incident this device is developed.

Fig 5.14. Photograph of Automatic protection module

Conclusion:-

- There may be an Automatic protection of crane hoist free-fall due to brake contactor stuck-up.
- There may be some portable type temporary barricading. That may be fixed around the area when the load is to be placed before starting lowering the hoist. Which may prevent serious injury to the person under Neath.

Chapter 6

Results & Graphs

6.1. Hazard Identification And Risk Assessment For Crane(Aspect of Production)

Table 6.1. Hazard Identification And Risk Assessment For Crane(Aspect of Production)

SERIAL NO	Tasks being performed	Safety Hazard and Health Hazard	Potential Harm	RE-Evaluation After Taking control Measure				
				C	E	P	SCORE	Risk Level (VH/HS/M/A)
A	FG HANDLING FROM MACHINE							
1	Providing the crane towards the recoiler of the machine.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
		Safety Hazard: Sling may get damaged,hook may fall down.	Physical Injury					
2	Lowering the hoist.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
		Safety Hazard: Sling may get damaged,hook may fall down.	Physical Injury/Material Damage					
3	Manual direction providing of the hook.	Health Hazard:NIL	NIL	15	1	3	45	M
		Safety Hazard: The hook	Physical Injury/Material Damage					

		may hit the helper who is providing the direction.						
4	Hoisting up the slitted FG.	Health Hazard:NIL	NIL	15	1	3	45	M
		Safety Hazard: If the mother coil breadth is more than the hook of the crane than there is a chance of slipping of the slit.	Physical Injury/Material Damage					
5	Giving direction towards the weigh scale.	Health Hazard:NIL	NIL	15	0.5	0.5	3.75	A
		Safety Hazard: Sling may get damaged,hook may fall down.	Physical Injury/Material Damage					
6	Giving direction towards the weigh scale.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
		Safety Hazard: While taking out the hook from ID of the coil it may hit the person on way. Operator may come in contact with other FG coils/equipment/Wooden	Physical Injury/Material Damage					

		saddle/packaging material.						
7	Writing the weight of the coil on the coil by marker or chalk.	Health Hazard:NIL	NIL	15	1	1	15	A
		Safety Hazard: While writing the weigt there may be a cut by the sharp edges of the coils.	Physical Injury					
B	TINPLATE/BINA METAL LOADING							
1	Providing the coil towards the trailer.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
		Safety Hazard: Sling may get damaged,hook may fall down.	Physical Injury/Material Damage					
2	The khalasi or driver manually gives direction needed to put the coil on the trailer.	Health Hazard:NIL	NIL	15	1	1	15	A
		Safety Hazard: The hook may hit the driver/khalasi who is providing the direction.	Material damage					
3	Several operations performing to fix the coil properly on the trailer.	Health Hazard:NIL	NIL				0	A
		Safety Hazard: If not properly	Physical Injury/Material Damage					

		placed on the trailer the coil may roll down.						
C	TELCO LOADING							
1	Providing the crane towards the hook - keeping rack near WIP rack.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
		Safety Hazard:Sling may get damaged,hook may fall down.	Physical Injury/Material Damage					
2	Providing the crane towards the hook - keeping rack near WIP rack.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard: Several operations at a time may lead to loose control.	Physical Injury					
3	While loading the second/third slit the helper provides a wooden block vertically in between two coils.	Health Hazard:NIL	NIL	15	2	0.5	15	M
		Safety Hazard: The wooden block may slip at any time & the coil may fall at any side.	Physical Injury/Material Damage					
D	LUDHIANA LOADING							
1	Since it is loaded with 3 slits in max at a time,if all three are not	Health Hazard:NIL	NIL	15	1	0.5	7.5	A

	together,they are taken together.							
		Safety Hazard: While taking the last slit the hook,already loaded with 2 slits may hit the coil & it may fall down.	Physical Injury					
2	Insertion of the hook into the nose of the tilter.	Health Hazard:NIL	NIL	15	1	1	15	A
		Safety Hazard: If not properly controlled the material may fall down.	Physical Injury					
3	The hook is taken out from the bottom of the tilter nose.	Health Hazard:NIL	NIL	15	1	0.5	7.5	A
4	The tilter special hook is manually dragged to place it below the slits from both sides.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard: While dagging the hook if not properly balanced,the helper may fall.	Physical injury					
5	It is placed below the I-shaped coils mounted on the tilter nose.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard: While placing the	Physical Injury					

		hook if not properly balanced,the helper may fall.						
6	It is placed below the I-shaped coils mounted on the tilter nose.	Health Hazard:NIL	NIL	15	1	1	15	A
		Safety Hazard: The hook loaded with coils may hit the driver & khalasi.	Physical Injury/Material Damage					
7	Climbing up the stair to board on the trailer.	Health Hazard:NIL	NIL	5	1			
		Safety Hazard: The operator may slip while climbing,keeping eye on the crane rather than on the steps.	Physical Injury					
8	Climbing down the stair to floor.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard:The operator may slip while climbing down,keeping eye on the crane rather than on the steps.	Physical Injury					
E	RM HANDLING							
1	Cutting the radial strip of the RM.	Health Hazard:NIL	NIL	**15**	1	1	15	A

		Safety Hazard: Strap may hit if he is not standing at opposite side of cutting	Physical Injury					
2	Placing the RM above & in between 2 RMs.	Health Hazard:NIL	NIL	**15**	1	0.5	7.5	A
		Safety Hazard: Coil May topple if the placement is not proper.	Physical Injury					
3	Coil Seaching through RM area	Health Hazard:NIL	*NIL*	**15**	1	0.5	7.5	A
		Safety Hazard: Leg cramp may happen if apprached on uneven floor without noticing	Physical Injury					
F	SIDE TRIM HANDLING							
1	Bringing of chain by dragging it from its place of keeping.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard:	Physical Injury					
2	Insertion of chain through the ID of the side trim.	Health Hazard:NIL	NIL	5	3	1	15	A
		Safety Hazard:	Physical Injury					
3	Pulling of chain for insertion in other side trims.	Health Hazard:NIL	NIL	5	3	3	45	A
		Safety Hazard:	Physical Injury					
4	Loading 2-3 slings at a time.	Health Hazard:NIL	NIL	5	1	3	15	A

		Safety Hazard:	Physical Injury					
5	Providing 2-3 slings towards the truck.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard:	Physical Injury					
6	Placing the side trims on the truck.	Health Hazard:NIL	NIL	5	3	3	45	A
		Safety Hazard:	Physical Injury					
7	The driver boards on the truck.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard:	Physical Injury					
8	Releasing the chain from the sidetrims.	Health Hazard:NIL	NIL	5	1	1	5	A
		Safety Hazard:	Physical Injury					
9	Sometimes by just hoisting up the crane the chain is released.	Health Hazard:NIL	NIL	15	2	1	30	M
		Safety Hazard:	Physical Injury					
10	Keeping the chain in its place.	Health Hazard:NIL	NIL	15	1	1	15	A
		Safety Hazard:	Physical Injury					
G	Coil Packaging or Jacketing/rejacketing							
1	Placing coil on wooden saddle. Placing outer GP wrap on FG coil	Health Hazard:NIL	NIL	**15**	1	1	15	A

6.2. **HIRA (During Crane Maintanance)**

Table 6.2. EOT Crane HIRA (During Crane Maintanance)

Serial No	Tasks being performed	Safety Hazard and Health Hazard	Potential Harm	RE-Evaluation After Taking control Measure				Risk Level (VH/HS/M/A)	Types of Hazard			
									S	H	B	E
				C	E	P	SCORE					
1.	Inspection of Equipments	S:Electricity,Gravity,Fall from height B: Improper PPE	Electrocution , Cut , Pinch	5	6	3	90	S	yes	No	yes	No
2.	Energy Isolation	S:Electricity , Gravity,Fall from height B: Non compliance of SOP	Electrocution , Cut , Pinch	5	6	3	90	S	yes	No	yes	No
3.	Tightning	S: Tool slippage,Fall from height	Cut , Pinch ,Hit, Strain	5	6	3	90	S	yes	No	yes	yes

		B: Improper Tool E: Hard To access										
4.	Working on Crab trolley	S: Tool slippage,Fall from height B: Improper Tool, Life Line E: Hard To access	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	yes
5.	Working on LT Plateform	S: Tool slippage,Fall from height B: Improper Tool	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	No
6.	Rope replacement	S: Tool slippage,Fall from height B: Improper Tool E:Improper position	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	yes
7.	Component Replacement	S: Tool slippage,Fall from	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	No

		height B: Improper Tool										
8.	Cable Wiring	S: Tool slippage,Fall from height B: Improper Tool	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	No
9.	Cable dressing	S: Tool slippage,Fall from height B: Improper Tool	Cut , Pinch ,Hit	5	6	3	90	S	yes	No	yes	No

6.3. **Activity Chart Of Eot Crane (C.E.P Scoring)**

Table 6.3. Diff. Activity Chart Of Eot Crane (Risk Calculation)

Sl.No.	Activity	Associated Hazard	Evalution C E P	Score	Risk Level	Score Bands
1	Starting the crane (switch on the crane)	a) Electrocution(E) b) Short circuit(E)	15 1.0 0.5 15 1.0 1.0	7.5 15	A A	Probably acceptable
2	Trial movement of L..T.& C.T. before engaging to job	a) Falling of loose bolts and other materials.(M) b) Leakage of oil from gear box.(M)	15 3.0 3.0 5.0 1.0 1.0	135 5.0	S A	Substantial risk Probably acceptable
3	Checking and selection of ‘C’ hooks & connecting with crane hook	a) Damage pad, injury during fixing temporary pad. b) Injury by falling of ‘C’ hook from stand.	5.0 3.0 10 15 3.0 01	150 45	S M	Substantial risk Moderate Risk

4	Checking and selection of slings & fixing with crane hook.	Improper size or damaged sling selected	5.0 0.5 5.0	12.5	A	Probably acceptable
5	Loading and un loading of coil with 'C' hook.	a) Toppling of coil from 'C' hook. b) Dislodging of coil from saddle.	25 3.0 6.0 15 3.0 6.0	450 450	VH VH	Very High Very High
6	Handling of Finish good/ Wooden pallet/ saddle/ Barrel by using slings	a) Breaking of slings b) Failure of 'D' shackle c) Injury by falling of material d) Entrapping finger while fitting edge protectors.	15 01 0.5 15 0.5 0.5 15 02 03 15 03 03	7.5 3.75 90 135	A A S S	Probably acceptable Substantial risk
7	Movement of crane with load.	a) Striking caring load with other materials/ equipments c) Colliding with other EOT engaged near by.	5.0 1.0 0.5 25 03 06	2.5 450	A VH	Probably acceptable Very High Risk

8	Movement of CT for positioning of materials.	a) Uncontrolled lowering of crane hoist with load. b) Striking with other materials or equipments	25 15	3.0 2.0	1.0 3.0	75 90	M S	Very High Risk Substantial risk

6.4. Safety Performance of last 10 years(No Of Near Miss)

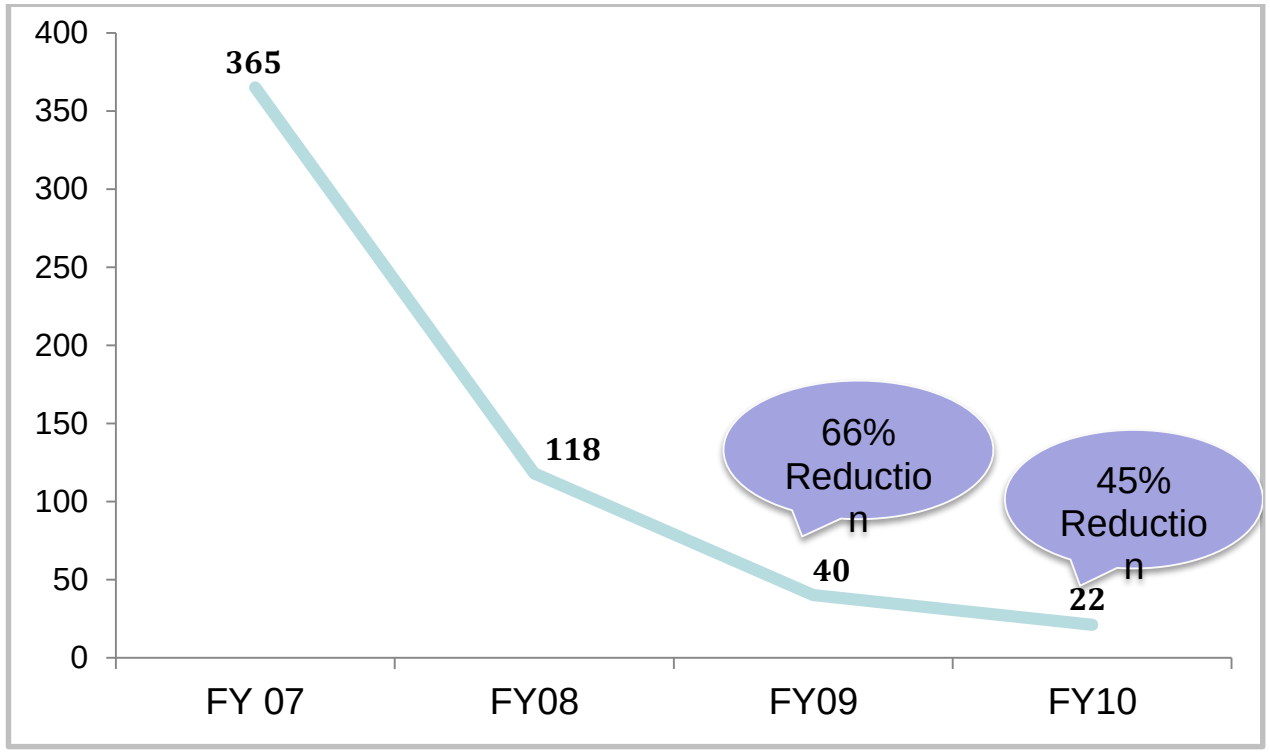

Fig 6.1. Number Of Near Miss

6.5. Data Collection From Past Incidents

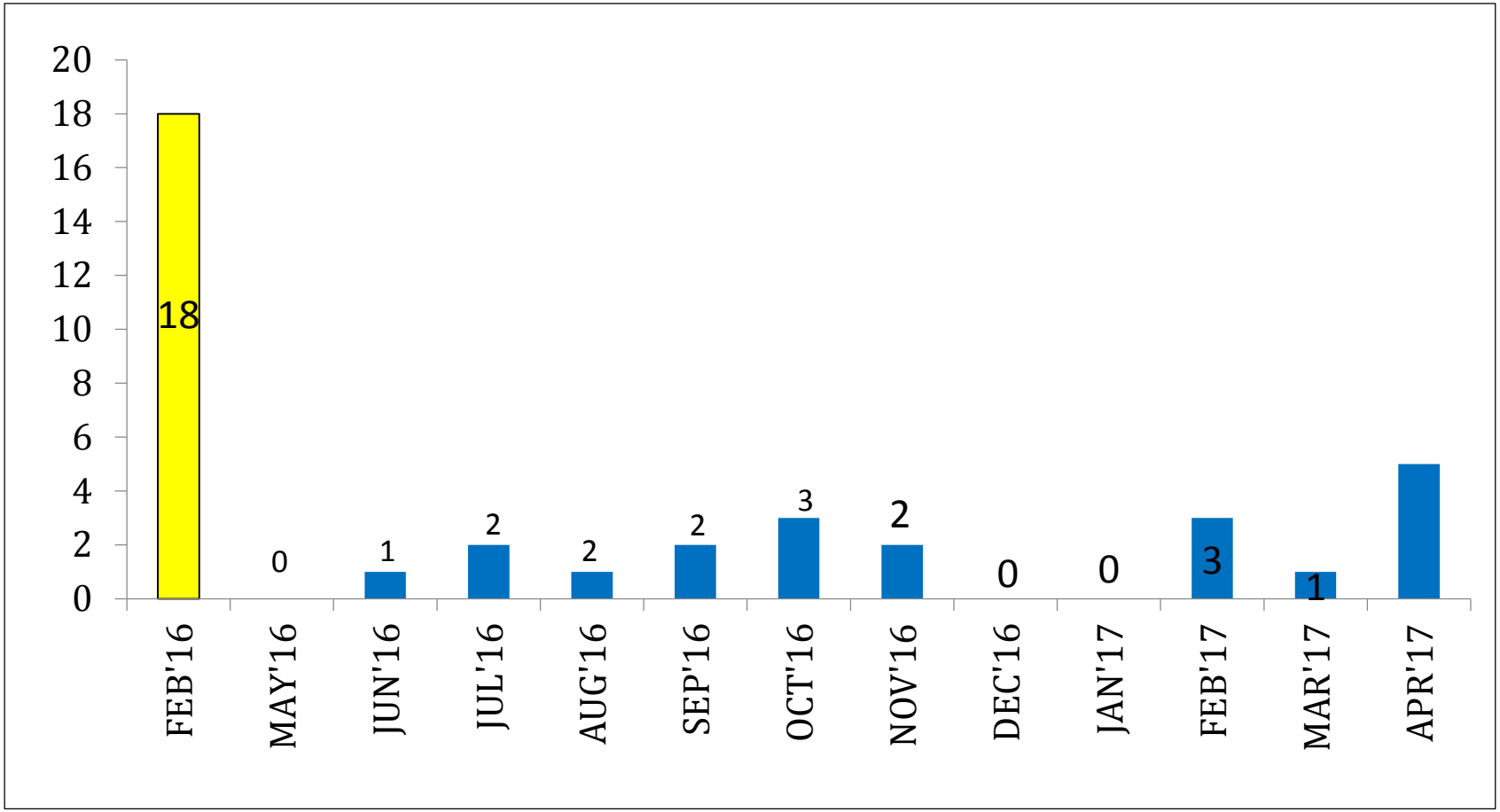

Fig 6.2. Data Collection From Past Incidents (2006 To 2017)

6.6. **Data Collection From 2006-2017 (Different Activity)**

Table 6.4. Data Collection From 2006-2017

Activity	2006 to 2008	2009 to 2011	2012 to 2014	2015 to 2017	Total
Toppling of coil from 'C' hook.	3	2	3	3	11
Dislodging of coil from saddle.	3	2	3	2	10
Uncontrolled lowering of hoist with load	4	1	1	2	8
Colliding with other EOT	1	1	0	2	4

6.7. **Job Cycle Check(JCC) Of E.O.T Crane**

Reviewer`s preparation

Department: Production

Operator :

EOT Crane no: ----------

Reviewer : Nitish Misra

SSOP NO:

Date: 00/00/0000

Time : 00:00 a.m/p.m

Activities Done:-

1. Selection of EOT in which JCC is to be performed.
2. Notifies the Employee with whom the JCC will be made & Fix up a time
3. Took photocopy of SSOP &gone through it.

Step-1: Off the job Evaluation on

Table 6.5. job Evaluation EOT Crane

Step no	Activity	Associated hazards	Responsibility	Precaution	Comments / Remarks
1	Operator Knowledge regarding crane	Operator must know the standard working load capacity of the crane main hoists, slings and C-Hooks in use.	Operator	All loads should be indicated with display.	Ok(As Per SSOP)
2	Operator Knowledge regarding Main switch	Operator must know the location and operating procedure of main switch of the respective crane	Operator	DSL breaker Display need to available	Ok(As Per SSOP)
3	Operator must know the crane capacity of	Otherwise in case of emergency he will not be able to control/stop the crane.	Operator	Loading, unloading working under capacity	Ok(As Per SSOP)

	main and hook.				
4	Check the battery condition.	Pressing start key for 05 seconds- If orange color light glows change battery immediately and if green, battery is ok. Otherwise crane may go out of control at any point of time	Operator	Orange color light glows change battery immediately and if green color light glows, battery is ok.	Ok(As Per SSOP)
5	Check all functions at no load.	Emergency stop button function, Lower Limit switch, Upper Limit Switch,	Operator	In case of mal function in any of those, Immediately hand over the crane to Maintenance crew.	Ok(As Per SSOP)
6	Check brake condition.	LT/CT Brake condition not properly ok condition cause incident happen	Operator	LT/CT Brake condition not properly ok condition cause incident happen	Ok(As Per SSOP)
7	Observe Hoist/LT/ CT functioning's.	Observe Hoist/ LT/CT movement noise. If found abnormal, don't run crane, inform maintenance people and submit the Remote to shift in	Operator	Observe Hoist/ LT/CT movement noise. If found abnormal, don't run crane, inform maintenance people and submit the Remote to shift in charge after parking the crane at non-working area.	Ok(As Per SSOP)

		charge after parking the crane at non- working area.			
8	Check the condition of wire rope, sling and c-hook.	Damaged EOT crane wired rope may leads to sudden collapse of load which may cause disaster to Human/ Property / Vehicle/ Etc.	Operator	Check the condition of wire rope for any rope sling strand broken/ breakage of strands and C-hook for cracks/ damage on C-Hook, don't run crane-Hand over it to maintenance team.	Ok(As Per SSOP)
9	Check the condition of safety latch	Check the condition of safety latch , If latch broken, immediately stop the operation and consult with the shift in charge	Operator	Check the condition of safety latch , If latch broken, immediately stop the operation and consult with the shift in charge	ok(As Per SSOP)
10	Removal of FG (sheet):	The packet may hit the helper if he is not away from the packet during movement	Operator	1. Ensure that the packet is properly packed. 2. Insert sling from both ends and at equal distance 3. Start lifting only after getting signal from helper Don't lift more than two packets at a time	ok(As Per SSOP)

				4. Place the packet by lowering slowly.	
11	Operator not maintain distance	The weight carried may hit leading to property damage and human injury.	Operator	Don't operate crane from more than 10 mtr distance	Operator & helper distance not maintain as per SSOP
12	Carry load at possible height	In case of brake failure/ rope breakage, property and human life can be saved	Operator	Carry load at minimum possible height	ok(As Per SSOP)

Step-2: Final Evaluation-

Table 6.6. Final Evaluation

Serialno	Activity	Current practice	Recommendation after discussion between reviewer and Employee
11	Operator & helper distance not maintain as per SSOP	Operator & helper distance not maintain	Don't operate crane from more than 10 mtr distance

Step-3:- Action plan

Table 6.7. Action plan

Serial no	Activity	Responsibility	Target date
3	Operator helper distance not maintain	Shift in charge/Supervisor	Immediate Action to be taken

Date:- --/--/---- Signature Of shift-charge

Chapter 7

Conclusion & Recommendations

7.1. Conclusion :- From the about research or project work it is observed that material handling activity is a very important activity in manufacturing or construction industry.the selection of the most appropiate material handling equipment for particular or appropiate application can be gives more profit of industry.thus it concludes that material handling system play a vital role in production,though material handling system is not a manufacturing process hence management of the industry does not value of that.about 30-75 % cost of the product depends upon material handling process.the one way to eliminate the accidents is identify the hazards and assess the relevant control measure taken with the cranes and bring the hazard to permissible level.lifting activity always involves some amount of hazards.hazard identification is carried out with the help of checklist method.Checklist method is the point to throughout survey of patricular task which is design first.it is widely accepted within industry in general that different hazard identification towards improvement in safety system of complex EOT crane operation.

7.2. Recommendations

On the basis of result and discussion, a number of very costs, easily implementable on this project, ergonomic problem solutions of this existing problems are recommended to the EHS Department, TSPDL for implementation to improve the working conditions, safe work method, productivity and finally occupational health and safety of the crane operator.Hazard identification of crane have been performed with the help of checklist inspection and C.E.P. score rating method and implement control measures have been given.

According to hierarchy hazard control explained that “hazard cannot completely eliminate” until it can be review continuously measures on workplace hazards.some preventive way to control hazards are given below

1. In place of using metal slings, the canvas lifting straps may be used for lifting F.G. packets. It may eliminate the activity of fixing edge protector reducing the risk of injury by entrapping finger between slings and goods packets.
2. The forklifts are used for handling materials from one bay to another bay where EOT crane approach is not available. But the Fork-lifts movement is very hazardous inside

shop floor as in the noisy shop floor the movement of the forklift may not be anticipated without viewing.The design of the forklift does not allow the handling of the goods packets at the eye level of the operator, there may be a chance to hit the goods packet column on which the materials are to be placed.

3. In a periodic cycle electrical, mechanical equipment maintenance of the crane components.
4. Regularly inspection and correction procedures of hazard are in place.
5. Within this surroundings, every worker should have adequate knowledge about their PPE's, lifting gears and emergency related equipment.
6. Ensure that, everyone understands and follow the standard safe operating process(SSOP).
7. All workers should attend all medical program in TSPDLplant.
8. Workers should be trained and training should be provided time to time regarding take place.
9. In the future installation of the new lifting, device worker should be trained about new installed machine operating process.
10. The length of pendent wire should be the similar level of height of the operator, which helps to increase more ergonomic condition.
11. Check the stability and physical condition of cranes, hooks, slings on a regular basis.
12. One operator should operate only one machine at a time.
13. Daily checklist to be up to date which helps to other shift operator assist the crane problem.preventive maintenance to be carried out once in 15 days.
14. Load testing examination performed once in a year of the crane.
15. Different welded joint of crane structure must be checked by non-destructive testing methods.
16. Crane operator should be placed into different groups, must always be operated by an associated group of an operator and they must not be interchanged.

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