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Risk Assessment in Maintenance Work at Diesel Locomotive Workshop

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ABSTRACT: The main objective of this paper is to identify the hazards and risk associated in various jobs in different sections which are being carried out in the Diesel Locomotive Workshop and to minimize the hazard in order to make the working environment safe for the workers. So for this purpose we have used Risk assessment methodologies such as Job Safety Analysis for identifying hazards and its consequences by analyzing all the processes in the workshop.

Keywords: Job Safety Analysis, Risk Rating, Diesel Locomotive Workshop

I. INTRODUCTION

Diesel Locomotive Workshop is a place where repair and maintenance of locomotive is carried out. During the maintenance work in diesel locomotive workshop there is the high probability of accidents on every working day. Various hazards are faced during maintenance & overhauling of locomotive, such as engine block, cylinder head, under frame, fuel injection pump (Mechanical Section), machines and equipments used during the maintenance work which may result in minor or major or fatality, due to this there is loss of man-hours and trained man-power which may directly affect the maintenance schedule. So a great concern is needed to minimize the occurrence of these hazards and for this purpose it is very necessary to analyze the risk associated in the working area. In our analysis we are performing the risk assessment in order to make the work place safe, As Workers and others have a right to be protected from harm caused by any kind of failure and also to take reasonable control measures which ever are necessary. For the purpose we will be using various risk assessment methodologies, Job Safety Analysis for identifying hazards and its consequences by analyzing all the processes which are being carried out in the workshop. Safety recommendation will be given on basis of above analysis to reduce the hazard during the maintenance work.

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II. METHODOLOGY

Risk assessment is a careful examination of what can cause harm to people in their work place so that one can check whether enough precautions are taken or should do more to prevent harm. And the first step to this is the hazard identification so that one could know whether what level of risk actually exists.

Job Safety Analysis: Job safety analysis is an accident prevention technique that is used to identify the potential hazard associated to the job and give the control measure to minimize the hazards.

An analysis includes five steps:

1. Select a job.
2. Break the job down into steps.
3. Identify the potential hazards.
4. Apply the controls to the hazards.
5. Evaluate the controls.

Both approaches to risk assessment are the most commonly applied. Risk assessment methods are quick and relatively easy to use as broad consequences and likelihoods can be identified and they can provide a general understanding of comparative risk between risk events, and the risk matrix can be used to separate risk events into risk classes (ratings).A logical systematic process is usually followed during a risk assessment to identify the key risk events and to assess the consequences of the events occurring and the likelihood of their occurrence.

Job Safety Analysis Worksheet
Cylinder head section

Company name: …… Date: ……
Site name: ……. Permit to work: ……
Unit Incharge: …….. Approved by: ……

S.N.	Work	Hazards	Controls
1	Replacement of cylinder head and re-assemble.	Valve spring puller bolts may bounce out and can hit on the workers face.	Trades of bolt and head must be same. Bolt should be properly tightened.
2	Hydraulic test of cylinder head.	Cock may hit the workers head, hand and legs while opening the pressure cock.	Hand should be away when air pressure cock is operated.
3	Transshipment of head	Head may slip from forklift.	Ensure lifting fork should not be greased, ensure limbs of fork should not be bend.
4	Fitment and removal of valve guide.	Slipping of distance piece from power press	Ensure distance at the time of Pressing, fit distance piece properly.
5	Grinding of valve seat insert.	Eye damage due to metal dust. Hand burn if worker touches the hot piece. Operator may get electric shock.	Check insulation and earthing periodically at the time of overhauling. Always use protective glasses.
6	Overhauling of valves (Grinding)	Entry of metal dust & grinding stone dust into mouth & eyes.	Use face mask.
7	Use of section's hoist	Fall of hoist from its foundation.	Ensure periodic inspection of foundation, ensure use of helmet.
8	Dipping of piston in cleaning tank.	Piston may slip & fall results in spillage of cleaning solution.	Ensure use of shoes, face mask and hand globes.

Job Safety Analysis Worksheet
Engine Block Section

Company name: …….. Date: ……
Site name: …….. Permit to work: ……
Unit In charge: …….. Approved by: ……

S.No	Work	Hazards	Controls
1	Removal and fitment of crank shaft.	Crank shaft may fall.	Use required PPEs, use proper lifting tackles and slings. At the time of shaft lifting any person should not be present under the crane.
2	Tuning of block.	Engine block may skid from turning rollers.	Use proper PPEs, ensure correct method for clamping. Ensure correct method for roller.
3	Checking of mandrel	Mandrel may fall.	Ensure correct fitting of sealing rope, lift in a proper angle, and use proper PPEs.
4	Removal and fitting of piston	Falling of piston, entanglement of figure while fitting connecting rod cap.	Use safety shoes, use proper tools, use helmet, crane operator should be trained, take precaution while manual cranking.
5	Removal and fitting of cam shaft and cam gear.	Entanglement of figure while fitting cam shaft & cam gear.	Use safety shoes, use proper tools, use helmet, crane operator should be trained, take precaution while manual cranking.
6	Removal and fitting of lifter pump.	Entanglement of figure while installing lifter pump.	Use safety shoes, use proper tools, use helmet, crane operator should be trained, take precaution while manual cranking.
7	Dismantling and refitting of piston and liner from engine block.	Piston and line may fall.	Ensure hole tapping, Clean carbon, Ensure proper chain and correct direction.
8	Lifting and placement of engine block with lifting tackle	While placing the engine block on the loco it may fall if loco & engine block are not near.	Do not stand under block, do not move long way at a time. Keep minimum required height.
9	Tightening & opening of main bearing cap & bolts	Spanner may slip while tightening & loosing of the main bearing cap bolt.	Use required PPEs, fit spanner properly, avoid jerking of spanner, Fit pipe properly
10	Rolling of engine block on turning roller	Engine block may skid.	Keep engine block properly on turning roller. Ensure proper tightening of lock plate. Use essential PPEs.

Probability	Severity			
	Ex. Harmful(4)	Harmful (3)	Slightly (2)	Insignificant-(1)
Very unlikely(1)	4	3	1	1
Unlikely(2)	8	6	4	2
Likely(3)	12	9	6	3
Very likely(4)	16	12	8	4

Matrix method in risk assessment is a semi-quantified way of evaluation. Risk value is determined by estimating of the potential severity of hazardous event and the likelihood that it will occur. Risk value is formulated as:

$$R = P \times S$$

Where:
P = Likelihood of occurrence
S = Potential severity of harm

Categories for likelihood of harm:

Very likely	4
Likely	3
Unlikely	2
Very unlikely	1

Categories for severity of harm:

Extremely harmful	4
Harmful	3
Slightly harmful	2
Very slightly harmful	1

Now
For Cylinder Head Section:
Work: Hydraulic test of cylinder head

$R = 4 \times 3$
$= 12$

Work: Replacing and Assembling of Cylinder Head.

$R = P \times S$
$= 4 \times 2$
$= 8$

Similarly
For Engine block Section
Work: Removal and fitting of cam shaft and cam gear.

$R = 1 \times 4$
$= 4$

I.e. the risk level is acceptable.
Work: Lifting and placement of engine block with lifting tackle

$R = P \times S$
$= 3 \times 2$
$= 6$

Risk rating criteria

Category of risk	Evaluation of tolerability
Very low (Level 1, 2, 3, 4)	Acceptable (or Negligible)
Low (Level 5, 6)	Risks that should be reduced so that they are tolerable or acceptable (Unwanted)
Medium (Level 8, 9)	Risks that should be reduced so that they are tolerable or acceptable (Unwanted)
High (Level 10, 12)	Risks that should be reduced so that they are tolerable or acceptable (Unwanted)
Very high (Level 15, 16,)	Unacceptable

III. CONCLUSION

The use of risk assessment methodologies contributes to the prevention of accidents and helps to make the system a safe place to work. Thus in this analysis Job Safety Analysis has been performed in every section of the workshop. Potential hazards associated to maintenance work under different section have been identified and proper control measures have been recommended by preparing Job Safety Analysis worksheet.
Risk Rating is also calculated of the each work as per hazards identified and listed in Job Safety Analysis worksheet which are performed during maintenance. This may help to know the level of risk faced while performing work.

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