Implementation of health and safety management system to reduce hazardous potential in PT.XYZ Indonesia

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Abstract. PT. XYZ is a large automotive manufacturing company that manufacture, assemble as well as a car exporter. The other products are spare parts, jig and dies. PT. XYZ has long been implementing the Occupational Safety and Health Management System (OSHMS) to reduce the potential hazards that cause work accidents. However, this does not mean that OSHMS that has been implemented does not need to be upgraded and improved. This is due to the potential danger caused by work is quite high. This research was conducted in Sunter 2 Plant where its production activities have a high level of potential hazard. Based on Hazard Identification risk assessment, Risk Assessment, and Risk Control (HIRARC) found 10 potential hazards in Plant Stamping Production, consisting of 4 very high risk potential hazards (E), 5 high risk potential hazards (H), and 1 moderate risk potential hazard (M). While in Plant Casting Production found 22 potential hazards findings consist of 7 very high risk potential hazards (E), 12 high risk potential hazards (H), and 3 medium risk potential hazards (M). Based on the result of Fault Tree Analysis (FTA), the main priority is the high risk potential hazards (H) and very high risk potential hazards (E). The proposed improvement are to make the visual display of the importance of always using the correct Personal Protective Equipment (PPE), establishing good working procedures, conducting OSH training for workers on a regular basis, and continuing to conduct safety campaigns.

Keywords: Potential Hazard, OSHMS, HIRA RC, FTA

1. Introduction

Today, the activity of a company is increasingly widespread, thus the greater the chance of potential hazards. In every production process, there are various potential hazards that can threaten workers' safety and health. Along with the advancement of knowledge and technology, the greater the challenge that must be faced by a manufacturing company, especially to overcome the problems of Occupational Safety and Health.

Division of stamping production and casting production is a division at PT. XYZ, where the production process at the plant has different potential hazard levels. The potential danger posed in these two divisions is very large, this is because plant stamping production is very closely related to press and dies machines weighing a few tons and also the noise level reaches 109 dB. Similarly, plant casting production, where most of the activity in the working environment is closely related to the temperature conditions that reach 700°C. Based on these considerations, a good safety and health management system is needed to ensure that potential hazards in the area can be minimized.

The aim of the research done is to determine the identification of potential hazards at Stamping Division Production and Casting Production at PT. XYZ, knowing the risk assessment of the potential hazard identification results, as well as finding the root cause of why it can occur.
Based on the Manpower Minister Regulation of the Republic of Indonesia (Permenaker RI) No.5 of 1996, the Occupational Safety and Health Management System is part of the overall management system which includes the organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development, implementation, achievement, review and maintenance of occupational safety and health policies for the creation of safe, efficient and productive workplaces [1][2]. Hazard Identification, Risk Assessment, and Risk Control (HIRARC) are key elements in the safety and health management system that are directly related to hazard prevention and control [3][4][5]. According to the Occupational Health and Safety Assessment Series (OHSAS): 18001 (2007), HIRARC must be conducted throughout the organization to determine the organization's activities that contain potential hazards and have a serious impact on occupational safety and health [6]. HIRARC is one of the potential hazard identification methods with risk assessment as one of the key points to implement the Occupational Safety and Health Management System. The purpose of HIRARC is to identify potential hazards in a company to assess the probability of an accident or financial loss. According to AS / NZS 4360 (2004), the HIRARC method used for risk assessment can be seen in Table 1 - Severity and Table 2 - Possible or Likelihood Rates [7].

### Table 1. Severity Level

| Level | Designation | Description |
|-------|-------------|-------------|
| 1     | Insignificant | Events do not cause harm or injury |
| 2     | Minor       | Inflict minor injuries, minor losses, and do not have a serious impact |
| 3     | Moderate    | Severe injuries and were hospitalized, huge financial losses |
| 4     | Major       | Cause severe injury, major financial loss, serious impact on production |
| 5     | Catastrophic | Resulting in dead and big losses until the cessation of all activities |

### Table 2. Likelihood Level

| Level | Designation | Description |
|-------|-------------|-------------|
| A     | Almost Certain | May occur at any time under normal conditions |
| B     | Likely      | Occur several times within a certain period |
| C     | Moderate    | Risks can occur but not often |
| D     | Unlikely    | Sometimes it happens |
| E     | Rare        | May occur under certain circumstances |

Based on the standard OHSAS 18001 (2007), Fault Tree Analysis (FTA) is a technique used to identify risks that contribute to accidents / losses. FTA is done with a top down approach, which begins with the assumption of failure or loss of a top event, then details the causes of a top event up to a basic failure [3]. Fault Tree Analysis is an effective method of finding the subject matter, as it ensures that an undesirable event or loss is caused not only to a point of failure. Fault Tree Analysis identifies the relationship between causal factors and is shown in the form of an error tree, which involves the use of simple logic gates.

### 2. Methods

Research begins with the identification of problems, obtained from field studies supported by literature studies. Because of the extent of the problem, the problem under study is limited to covering OSH management in one plant unit, namely Plant 2 Sunter. The next stage is data collection covering the potential hazards and implementation of OSHMS. Furthermore, a potential hazard analysis with Fault Tree Analysis (FTA) was conducted. The results concluded are taken into consideration to formulate the proposed improvement, so it is expected to reduce the risk of accident and occupational safety.
3. Results and discussion

3.1. Hazard Identification, Risk Assessment and Risk Control (HIRARC)
At this stage, hazard identification of potential hazards has been identified. Then measured risk based on severity (severity) and likelihood (level of possibility). Risk assessment provides scores of any potential hazard findings and calculates the Risk Priority Index (RPI) level for each potential hazard. Potential occupational hazards in the area of stamping production plant by using HIRARC method identified 10 potential hazards. Risk assessment on plant stamping production can be seen in Table 3. Then, the risk category is made on the risk matrix map based on the RPI value obtained from the risk assessment stage. This risk mapping indicates the position of the RPI in each potential hazard finding to find out which activities need action, based on high risk to extreme risk. Matrix analysis on plant stamping production can be seen in Table 4.

| No | Location | Hazards | Picture | Effects | Severity | Likelihood | RPI | Risk Category |
|----|----------|---------|---------|---------|----------|------------|-----|---------------|
| 1  | Kaizen Stamping | Working at altitude does not use safety guard | | Operator dropped from a height | 3 | C | 3C | H |
| 2  | Line Z Stamping | Operator is setting the material to the die | | Operator can be slashed by material | 2 | C | 2C | M |
| 3  | Line Z Stamping | Operator is fixing the die inside the stamping machine area | | Operator can be hit by die | 5 | B | 5B | E |
| 4  | Line Z Stamping | Operator is installing a cushion pin | | Operator may have a back injury | 3 | B | 3B | H |
| 5  | Line I Stamping | Operator is operating crane | | Operator can be hit by die | 5 | B | 5B | E |
| 6  | Line I Stamping | Operator is doing press process | | Operator's hand may be pinched by die | 4 | B | 4B | E |
### Table 3. Risk Assessment on Stamping Production Plant (cont.)

| No | Location | Hazards | Picture | Effects | Severity Likelihood | RPI | Risk Category |
|----|----------|---------|---------|---------|---------------------|-----|---------------|
| 7  | Line C Stamping | Forklift operator A puts the die, and Operator B places a mat for the die | Operator B may be struck by die / hit by forklift | 4 | B | 4B | E |
| 8  | Line C Stamping | Operator is not on track to cross | Operator may get hit by a forklift | 4 | D | 4D | H |
| 9  | Scrap Conveyor | The noise level in the area reached 109 db | Hearing function will decrease (because noise level above 80 dB) | 4 | A | 4A | E |
| 10 | Line H Stamping | Operator is moving the material | Operators who are on the green line may be hit by a forklift | 4 | D | 4D | H |

### Table 4. Matrix Analysis on Stamping Production Plant

| Likelihood | Insignificant 1 | Minor 2 | Moderate 3 | Major 4 | Catastrophic 5 |
|------------|----------------|---------|------------|---------|----------------|
| A (Almost certain) | H (9) | H | E | E | E |
| B (Likely) | M | H | H (4) | E (6,7) | E (3,5) |
| C (Possible) | L | M (2) | H (1) | E | E |
| D (Unlikely) | L | L | M | H (8,10) | E |
| E (Rare) | L | L | M | H | H |

In addition to plant stamping production, risk assessment of potential hazards is also done in the area of plant casting production using the HIRARC method. The results are identified as 22 potential hazards and can be seen in Table 5.

### Table 5. Risk Assessment on Casting Production Plant

| No | Location | Hazards | Effects | Severity | Likelihood | RPI | Risk Category |
|----|----------|---------|---------|----------|------------|-----|---------------|
| 1  | Line Melting Casting | Setting ladle to dolly burner using forklift | The operator may be hit by heavy objects | 5 | B | 5B | E |
Table 5. Risk Assessment on Casting Production Plant (cont.)

| No | Location | Hazards | Effects | Severity | Likelihood | RPI | Risk Category |
|----|----------|---------|---------|----------|------------|-----|---------------|
| 2  | Line Melting Casting | Put ingots into the furnace | Operator can be exposed to heat materials | 3        | B          | 3B  | H             |
| 3  | Line Melting Casting | Forklift enter to pouring work area | Operator may be hit by forklift | 4        | D          | 4D  | H             |
| 4  | Line Melting Casting | The liquid from furnace 6 is poured into furnace 3 through ladle transfer Sprinkle the husks into the walls of the furnace (full open robusta) | Operator can be exposed to heat materials | 3        | B          | 3B  | H             |
| 5  | Line Melting Casting | Other operators passing forklift unloading area | Operator may be hit by forklift | 4        | D          | 4D  | H             |
| 6  | Line Melting Casting | Push the dolly material into the front of the furnace across the crane path | The operator may be hit by heavy objects | 5        | B          | 5B  | E             |
| 7  | Line Melting Casting | Reversing the slag box | Operators may be knocked by objects for himself | 2        | C          | 2C  | M             |
| 8  | Line Melting Casting | Take the liquid from the furnace | Operators may be contacted with hot material | 3        | B          | 3B  | H             |
| 9  | Line Melting Casting | Check the temperature of the furnace fluid | Operator can be exposed to heat materials | 3        | B          | 3B  | H             |
| 10 | Line Melting Casting | Sprinkle kagaraito evenly over the furnace liquid | Operator can be exposed to heat materials | 3        | B          | 3B  | H             |
| 11 | Line Melting Casting | Clean up the remaining charging around the furnace | Operator can be exposed to heat materials | 4        | B          | 4B  | E             |
| 12 | Line Melting Casting | Bring the ladle from the furnace to the pouring area | Operators can be wedged by machine | 4        | C          | 4C  | E             |
| 13 | Line Melting Casting | Fix the furnace and pull the hose and cross the crane path | Operators may fall because there are objects blocking | 3        | C          | 3C  | H             |
| 14 | Line Melting Casting | Moving the pallet forks of a fork into a wooden pallet | Operator may be hit by forklift | 4        | C          | 4C  | E             |
| 15 | Line Melting Casting | When the hopper is up / down can overwrite other team members who pass | Operators can be hit by forklift | 4        | C          | 4C  | E             |

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**Table 5. Risk Assessment on Casting Production Plant (cont.)**

| No | Location | Hazards | Effects | Severity | Likelihood | RPI | Risk Category |
|----|----------|---------|---------|----------|------------|-----|--------------|
| 17 | Line RCS Casting | When sacks up / down can be fall other team members who pass. | Operators can hitte by the sack | 3 | C | 3C | H |
| 18 | Line Molding Casting | Operator standing on H-Beam with a height of ± 3 meter | Operators can fall from a height > 2 meter | 3 | D | 3D | M |
| 19 | Line Melting Casting | Operator is too close to the hopper door | Operators can fall from a height > 2 meter | 3 | C | 3C | H |
| 20 | Line Melting Casting | Lifting the sand from the pit using a hoist | Operators can fall from a height > 2 meter | 3 | C | 3C | H |
| 21 | Line Core Casting | Lifting die from floor to dolly transfer | Operator may hitte by die | 5 | B | 5B | E |
| 22 | Line Core Casting | Delivery sand to zone B with forklift, other operators working in forklift path | Operator may hitte by forklift | 4 | D | 4D | H |

Then, based on the value of RPI is made a risk matrix map. This risk mapping shows the position of the RPI in each potential hazard finding. This is to find out what activities need to be taken to reduce the risk of work accident. Matrix analysis on casting production plant can be seen in Table 6.

**Table 6. Matrix Analysis on Casting Production Plant**

| Likelihood | Insignificant 1 | Minor 2 | Consequence Moderate 3 | Major 4 | Catastrophic 5 |
|------------|-----------------|---------|------------------------|---------|----------------|
| A (Almost certain) | H | H | E | E | E |
| B (Likely) | M | H | H (2,4,9,10,11) | E (12) | E (1,7,21) |
| C (Possible) | L | M (8) | H (5,14,17,19,20) | E (13,15,16) | E |
| D (Unlikely) | L | L | M (18) | H (3,6,22) | E |
| E (Rare) | L | L | M | H | H |

### 3.2. Fault Tree Analysis (FTA)

The next stage is to find the cause of the incident related to the highest risk and extreme risk by using fault tree analysis (FTA). The peak events identified in plant stamping production are 9 occurrences of high risk and extreme risk potential hazards. In the casting production plant, there are 20 occurrences of high risk and extreme risk potential hazards. Here are the results of FTA analysis of some potential hazard causes in stamping production plant and casting production plant which can be seen in Figure 1 and Figure 2.
3.3. Recommendation for Improvement

Based on the results of risk assessment data processing using HIRARC method, can be grouped several proposed precautions based on the assessment of the high risk and extreme risk hazards. Recommendations for improvement on stamping production plant and casting production plant can be seen in Table 7 and Table 8.

Figure 1. Causes of Potential Hazards of Falling from Height in Stamping Production Plant

Figure 2. Causes of Potential Hazards of Hot Material Affected in Plant Casting Production
Table 7. Recommendation for Improvement on Stamping Production Plant

| No. | Hazard Potential | Cause                                                                 | Consequence         | Action                                                                 |
|-----|------------------|------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------|
| 1   | Working at an elevation does not use complete PPE | 1. Not using PPE  
2. Low awareness and knowledge of occupational safety and health  
3. No supervision from management  
4. There are objects that interfere / obstruct  
5. Slippery conditions  
6. Work time in a hurry | Falling from a height | 1. Create a visual display so that workers always wear PPE (safety harness when working at altitude)  
2. Create clear and correct working procedures  
3. Perform OSHMS training to workers on a regular basis |
| 2   | Operator is installing cushion pin | 1. Cushion is too heavy  
2. There is no cushion lifting tool, so it must be done manually  
3. No supervision from management | Back injuries | Designing a system of common use cushion, eliminating the need for disassembly cushion |

Table 8. Recommendation for Improvement on Casting Production Plant

| No. | Hazard Potential | Cause | Consequence | Action                                                                 |
|-----|------------------|-------|-------------|------------------------------------------------------------------------|
| 1   | Setting ladle to dolly burner using forklift | 1. No supervision from management  
2. There are objects that interfere / obstruct  
3. Slippery conditions  
4. No boundaries | Crushed by heavy objects | 1. Create clear and correct working procedures  
2. Create a barrier  
3. Routine supervision  
4. Perform OSHMS training to workers on a regular basis |
| 2   | Put ingots into the furnace | 5. Not using PPE completely  
6. No supervision from management  
7. No boundaries | Crushed by very hot material | 5. Create clear and correct working procedures  
6. Create a barrier  
7. Routine supervision  
8. Perform OSHMS training to workers on a regular basis  
9. Using PPE completely |

4. Conclusion

Based on the results of data processing and analysis that has been done, can be drawn conclusion as follows:

1. Identification of the greatest potential hazard is found in the casting production plant that is 22 potential hazards.

2. Based on Hazard Identification risk assessment, Risk Assessment, and Risk Control (HIRARCY) found 10 potential hazards in Plant Stamping Production, consisting of 4 very high risk potential hazards (E), 5 high risk potential hazards (H), and 1 moderate risk potential hazard (M). While in Plant Casting Production found 22 potential hazards findings consist of 7 very high risk potential hazards (E), 12 high risk potential hazards (H), and 3 medium risk potential hazards (M).

3. The proposed improvement are to make the visual display of the importance of always using the correct Personal Protective Equipment (PPE), establishing good working procedures, conducting OSH training for workers on a regular basis, and continuing to conduct safety campaigns.
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