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Vehicle Loading and Unloading Activities at MV Aishakamilah, Hazard Identification, Risk Assessment and Risk Control

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KEYWORDS
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Risk Assessment
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ABSTRACT – This research is to determine risk control from the results of identifying hazards that are likely to occur in loading and unloading activities on the MV. Aishakamilah. The informans in this study were operational workers and crew of Kalla Lines at the port totaling 20 people with the Purposive Sampling technique. The results of this study found that the identified hazards in the vehicle loading and unloading process at MV. Aishakamilah, operated by PT. Bumi Lintas Tama, there were 21 identified hazards. The results of the risk assessment obtained from the 21 identified hazards from the loading and unloading process activities on the MV. Aishakamilah at the PT. Bumi Lintas Tama Car Terminal, there were results from the risk level after control was carried out, namely the High Risk level of 0 risks, the Moderate Risk level of 3 and the Low Risk level of 18 risks. From the observations conducted by researchers in the field, the loading and unloading activities on the MV. Aishakamilah have 4 risk control hierarchies applied. The risk controls applied are substitution, engineering, administration, and personal protective equipment. From the results of the study, a way to reduce the level of risk of danger in vehicle loading and unloading operations on the MV. Aishakamilah is obtained by conducting a briefing before carrying out loading and unloading activities and always paying attention to PPE in working and paying attention to applicable standard operating procedure (SOP).

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INTRODUCTION

Occupational Safety and Health (OSH) stands for occupational safety and health and is an important field in the shipping industry [1]. OSH in shipping companies is related to efforts to protect employees, ships, and the work environment from hazards and risks associated with maritime operations. The main objective of the Occupational Safety and Health (OSH) program in shipping companies is to prevent work accidents, injuries, negative health impacts, and increase employee productivity [2]. Occupational safety is safety related to human work activities both in industry, manufacturing and construction, which involve machines, equipment, work tools, raw materials and their processing, workplace foundations and their environment and ways of doing work, as well as service industries, which involve equipment, transportation systems and others [3], [4].

The occupational safety system is known as "Safety First" [5]. Safety First is a principle or approach that places safety as the top priority in all situations or activities [6], [7]. This principle refers to the need to protect and ensure the safety of individuals or groups before considering other factors, such as efficiency or productivity [8]. Occupational health in a company is a specialization in the science of health practice by conducting an assessment of the factors that cause disease in the work environment and company through measurements whose results are used as a basis for corrective action and if necessary prevention of the environment, so that workers and the surrounding community of the company are protected from the dangers of work results, and it is possible to experience the highest level of health [1], [9]

METHOD

This study uses descriptive analysis techniques with a qualitative approach. This study is a study with a case study method or approach, qualitative descriptive which is descriptive, explaining, and describing the object being studied. This study will produce descriptive data, in the form of written or oral data from people and behavior that can be observed as objects of research. This study was conducted at the Port of Makassar, precisely during the unloading activities of the MV. Aishakamilah owned by Kalla Lines. The port is located at Jl. Nusantara No. 378, Butung, Wajo District, Makassar City, South Sulawesi, Indonesia. The position of the ship's berth at Soekarno Hatta port depends on the agreement during the ship's berth determination meeting which has been carried out with shipping company agents in Makassar. Usually the ship's schedule in a month has 5 trips. The Kalla Lines company is a company that provides transportation services for vehicles, heavy equipment, and cargo from Makassar to Jakarta and vice versa. The informans in this study were operational workers and Kalla Lines crew at the port totaling 20 people. In this study, the author used the Purposive Sampling technique [10]. Furthermore, the questions was distributed to 20 people involved

in loading and unloading activities on the MV. Aishakamilah precisely at the Soekarno Hatta Makassar port. The data collection techniques used in this study were questionnaires, documentation, and observation techniques. Hazard Identification Risk Assessment and Determining Control (HIRADC) Data Collection and Processing consists of types of activities and field conditions, potential hazards and risks, severity levels, frequency levels, and risk values and risk levels.

RESULTS AND DISCUSSION

Hazard Identification, Risk Assessment and Determining Control (HIRADC)

Based on the results of research and direct observation in the field, the application of Hazard Identification, Risk Assessment and Determining Control (HIRADC) in the process of loading and unloading vehicles from ships to the stacking yard or vice versa from the stacking yard to the ship in meeting the requirements of OHSAS 18001:2007 clause 4.3.1 "Hazard Identification, Risk Assessment and Determining Control" obtained the following results. In the loading and unloading process, it begins with health checks for drivers, operational staff, security, and all workers involved in loading and unloading activities [11]. Furthermore, the process of checking the completeness of workers such as wearing wearpacks, shoes, gloves, vests and not using accessories such as watches that can cause scratches (defects) when carrying out loading and unloading activities. Then continued with the process of transferring cargo, because the ship used is a RORO (Roll on Roll Off) ship where vehicles can go up and down through the ship's door which can also be a connecting bridge between the ship and the dock where this door is also called a ramp door. Where in this activity there are many potential hazards that may arise such as slipping, collisions, and so on that may occur so that it is necessary to create a Hazard Identification, Risk Assessment and Determining Control (HIRADC) [12]. HIRADC methods are important elements in OHSAS because they are directly related to efforts to prevent and control hazards that are used to determine objects and occupational safety and health plans [13]. HIRADC is one part of the OHSAS 18001:2007 standard, clause 4.3.1, which states that companies must establish, create, implement and maintain procedures, namely by identifying hazards, assessing risks and determining the necessary hazard and risk controls[14].

Observation

Based on the results of field observations, researchers found unsafe actions or dangerous actions whose factors came from workers, such as:

a. Workers do not wear gloves when driving cars.
b. There are tallyment workers who do not wear safety vests.
c. Drivers work recklessly driving vehicles which can cause accidents such as collisions.
d. There are maintenance workers who go around using motorbikes without wearing safety helmets and park their motorbikes near the rampdoor.

Objects and Subjects of Observation

The object and subject of observation are identifying hazards, risk assessment and risk control using the HIRADC method in the loading and unloading process on the MV. Aishakamilah. Analysis of the data obtained in the form of hazard and risk identification data then the level of risk before and after the implementation of control with the aim of reducing the level of risk.

Hazard Identification Observation

To obtain hazard identification, reference collection, direct observation, interviews and questionnaires are carried out with several workers related to potential hazards by conducting Hazard Identification for all observation objects. In the work there is preparatory work from the work stage based on references and field observation results, hazard identification is obtained, as can be seen in Table 1.

Next, the hazard identification steps with the HIRARC criteria that classify the hazard sources and the frequency of the hazard sources. There are 6 hazard sources from the potential hazards in the research location, and from the six hazard sources, there is a frequency of hazard sources, namely: being hit by a vehicle or heavy equipment, broken lashing rope, burst tires, work areas in extreme places.

Risk Control

Risk control is an effort to assist companies in the risk identification process to reduce or minimize work accidents. Risk control is carried out so that every risk that has the potential for danger is reduced to a safe point. Risk control has an important role in HIRADC to reduce the level of risk of danger by considering the hierarchy of risk control, namely, elimination, substitution, engineering / design control, administrative control and personal protective equipment. The following are risk control actions based on the hierarchy of hazard control that can occur at any time:

Table 1. Identification of Hazards and Risks

No	Activities	Hazards	Risks
1	Vehicle defect checking by QC	• Climbing and descending stairs repeatedly • Hit by a vehicle	• Slipping • Injury • Death
2	Lashing rope attachment to vehicle	• Lashing rope • Caught by a vehicle while installing the lashing rope	• Serious injury (broken bones) • Death • Loss
3	Vehicle boarding and disembarking process passing through ramp door	• Ban Tire burst • Collision with another vehicle	• Loss • Injury • Property Damage
4	Tallyman activity recording/reporting	• Exposure to sunlight • Tallyman hit by vehicle while checking	• Injury • Death • Fatigue while working • Dehydration
5	Cargo load transportation	• Hit by cargo • Cargo dropped and contents fall out • Vehicles carrying cargo exceeding capacity	• Injury • Loss • Death • Unsafe materials/ contents of cargo
6	Field conditions	• Uneven roads • Dusty roads • Slippery roads	• Slipping • Injury • Vehicle damage • Respiratory tract infection

1. Elimination - modifying the design to eliminate hazards; for example, introducing mechanical lifting devices to eliminate manual handling of hazards
2. Substitution - substituting less hazardous materials or reducing system energy (for example, reducing power, amperage, pressure, temperature, etc.).
3. Engineering / design control - installing ventilation systems, guard machines, interlocks, etc.
4. Administrative control - safety signs, hazardous area signs, photo-luminescent signs, signs for pedestrian walkways, warning sirens / lights, alarms, safety procedures, equipment inspections, access controls, safe systems, markings, and work permits, etc. Administrative control measures are those who carry out work in accordance with the SOP (Standard Operating Procedure) that has been set by the company, such as the implementation of the placement of K3 signs in places that have the potential to be dangerous, and direct supervision from HSE such as, workers attending K3 briefings after changing shifts or before carrying out operations, operator training, operators must have SIO (Operator License), health checks before operating equipment, socialization of the impact of environmental pollution, providing safe speed limits.
5. Personal Protective Equipment (PPE) - safety glasses, hearing protection, face shields, respirators, and gloves, safety shoes. The use of personal protective equipment is carried out to prevent / reduce the severity if a work accident occurs. Personal protective equipment is given to loading and unloading workers in the field. Table 2 shows hazard and risk identification along with risk control from the results of hazard identification.

Risk Assessment

Risk assessment is the process of assessing the magnitude of risks identified in the loading and unloading process of vehicles. Determining the Likelihood and Severity values of each identified potential hazard and the magnitude of the risk.

1. Risk Assessment Before Control

Risk Assessment is conducted with the aim of determining the level of risk that has been carried out after conducting hazard identification. Table 3 reveals the risk levels before control is carried out.

Table 2. Risk Control

No	Activities	Hazards	Risks	Control
1	Vehicle defect checking by QC	• Climbing and descending stairs repeatedly • Hit by vehicle	• Slipping • Injury • Death	**ADM:** Train employees on defect handling and safety procedures, keep work areas free from distractions and hazards, conduct periodic safety audits to ensure compliance with load safety procedures **PPE**: Gloves, shoes, and safety glasses
2	Lashing rope attachment to vehicle	• Broken lashing rope • Caught by vehicle while installing lashing rope	• Serious injury (fracture) • Death • Loss	**ADM:** workers attend mandatory briefings before starting activities, provide special training related to work and K3, socialize the dangers of work accidents. **APD:** Mandatory APD, Safety Shoes, Full Body Harness
3	Vehicle boarding and disembarking process passing through ramp door	• Blown tire • Collision with other vehicle	• Loss • Injury • Property damage	**ADM:** Identify all potential hazards associated with the vehicle, such as mechanical hazards, environmental hazards and operational hazards, provide adequate training to operators on safe operating procedures, emergency response, warnings, and verbal communication to inform workers of hazards and safety procedures. **PPE:** Non-slip shoes, Safety helmets, gloves and masks, protective clothing, eye protection**.**
4	Tallyman activity recording/reporting	• Exposed to sunlight • Tallyman hit by vehicle while checking	• Injury • Death • Fatigue while working • Dehydration	**ADM:** attend K3 Briefing, conduct operator training and tally radio function checks before starting loading and unloading services, and maintain visibility between the operator and tally **PPE:** Mandatory PPE, helmet, safety shoes, safety vest.
5	Cargo load transportation	• Hit by cargo • Loaded cargo falls and its contents fall out • Vehicle carrying cargo exceeding capacity	• Injury • Loss • Death • Unsafe materials/contents of cargo	**ADM:** K3 Briefing, operator training, operator certification, giving warning signs (K3 signs) **PPE:** Safety Helmet, Safety Shoes, Mask.
6	Field conditions	• Uneven road • Dusty road • Slippery road	• Slipping • Injury • Vehicle damage • Respiratory tract infection	**ADM:** Keep the work area clean from liquid spills and obstacles, use non-slip flooring materials in risk areas, ensure adequate lighting in the work area, provide regular K3 training for all workers, only allow trained and certified operators to operate heavy equipment and vehicles **PPE**: Non-slip shoes, Protective helmets, gloves and masks, protective clothing, eye protection and safety belts.

Table 3. Risk Level Analysis Results before Control

No	Job Activity	Initial Risk			Risk Level
		L	M	H	
1.	Vehicle defect checking by QC	0	3	1	4
2.	Lashing rope attachment to vehicle	2	1	0	3
3.	Vehicle boarding and disembarking process passing through ramp door	1	2	0	3
4.	Tallyman Activity Recording/reporting	2	1	0	3
5.	Cargo load transportation	1	2	1	4
6.	Field Conditions	3	1	0	4
	Total Risks	**9**	**10**	**2**	**21**

Based on table 3. the results of the risk level analysis in the loading and unloading process at the MV. Aishakamilah before risk control, the following results were obtained:

a. Work with a High Risk (H) level has 2 hazards and risks, namely damage to safety equipment. Work with a high-risk level is usually work from excavators.
b. Work with a Moderate Risk (M) level has 10 risks, namely exposed electrical cables, system or tool damage and, worn seat belts, brake failure, material spills, steep slopes, officers exposed to hazardous chemicals and errors in storing equipment and supplies.
c. Work with a Low Risk (L) level has 9 risks, namely material spills, extreme weather, oil leaks, damaged fuel tanks, damaged or malfunctioning control levers, tool overload, defective helmets, noise exposure and dust exposure, Work with a low risk level is usually work that does not cause serious injuries.

The results above show an average of Low-Risk jobs where the job does not cause serious injuries, Moderate Risk jobs where the job is dangerous and requires medical care but does not cause lost work days or death and High Risk jobs where this job has a high risk that can cause serious injuries that require medical care and lost work days or even cause death.

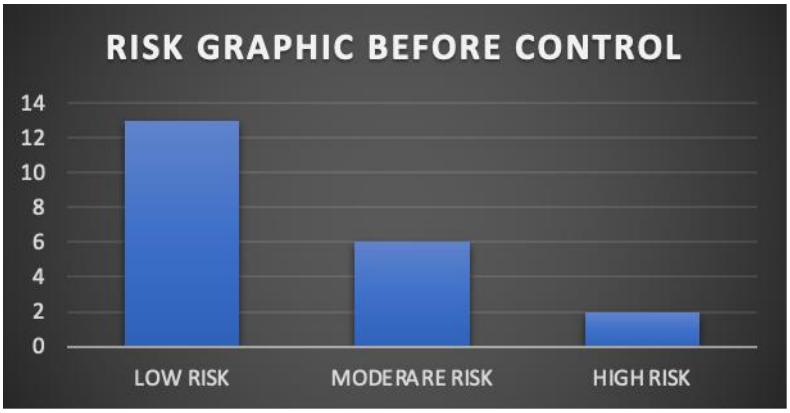

Figure 1. Risk before control

Table 4. Risk Assessment Parameter Matrix Before Control

Probability		Severity: Not Significant (1)	Low (2)	Moderate (3)	High (4)	Extreme (5)
Almost Certain	5	Hit by a vehicle that is loading and unloading	H	E	E	E
	4	Climbing and descending stairs repeatedly	Tire burst	Brakes not working	E	E
Often Occurs	3	Exposed to sunlight	Cargo transport vehicles exceeding capacity	Crashed by cargo	Collision with another vehicle	E
Can Occur	2	Spills of material, Extreme weather, Overloaded cargo	Steep slopes, Officers exposed to hazardous chemicals.	M,	M	H
Rarely happening	1	L	L	L	L	M

Information:

E	= Ekstreme Risk
H	= High Risk
M	= Moderate Risk
L	= Low Risk

So from the 21 risk levels that have been analyzed from the HIRADC table and if put into percentage form, the results obtained from the assessment before control is carried out are as follows:

$$R = \frac{Total\ Risk}{Total\ Overall\ Risk} \times 100\%$$

$$\text{High Risk} = \frac{2}{21} x\ 100\% = 9{,}5\ \%$$

$$\text{Moderate Risk} = \frac{10}{21} x\ 100\% = 47{,}6\ \%$$

$$\text{Low Risk} = \frac{9}{21} x\ 100\% = 42{,}8\ \%$$

From the results of the risk assessment before control was carried out, the percentage form above shows that High Risk level work gets a percentage of 9.5%, Moderate Risk level work gets a percentage of 47.6% and Low Risk level work gets a percentage of 42.8%.

2. Risk Assessment After Control

This discussion aims to determine the level of risk after risk control is carried out with HIRARC. The risk control hierarchy used in this study includes:

a. Elimination.
b. Substitution.
c. Engineering Control.
d. Administration.
e. Personal Protective Equipment.

Risk control is carried out so as not to cause work accidents and losses for the company and for the workers themselves. Risk control is carried out in an effort to control a risk in order to minimize work accidents and losses for the company. Risk control is very important in risk management. The results of observations made by researchers on the MV. Aishakamilah owned by PT. Bumi Lintas Tama, there are 5 risk control hierarchies applied. The risk controls applied are substitution, elimination, engineering, administration, and personal protective equipment. Then the results of the risk level obtained after carrying out control can be seen in Table 5:

Table 5. Risk Level After Control

No.	Job Activity	Initial Risk			Risk Level
		L	M	H	
1.	Vehicle defect checking by QC	3	1	0	4
2.	Lashing rope attachment to vehicle	3	0	0	3
3.	Vehicle boarding and disembarking process passing through ramp door	2	1	0	3
4.	Tallyman Activity Recording/reporting	3	0	0	3
5.	Cargo load transportation	4	0	0	4
6.	Field Conditions	3	1	0	4
	Amount of Risk	**18**	**2**		**21**

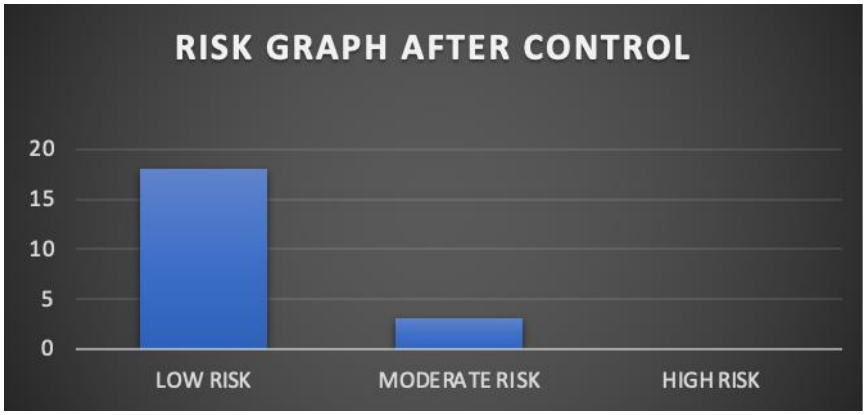

Figure 2. Risk after control

Based on table 5. the results of the risk level analysis after control were carried out on the loading and unloading process, the following results were obtained:

a. Work with a High-Risk level (H) before control was carried out as many as 2 risks, and after control was carried out it decreased or was reduced to a Medium Risk level and became 0 risk at a High-Risk level. There are no more high-risk jobs after risk control was carried out.
b. b. Work with a Moderate Risk level (M) before control was carried out as many as 10 risks. And after risk control was carried out, the risk level decreased or was reduced to a Low Risk level. The existing Moderate Risk level is the result of a decrease or reduction in the results of the High-Risk level.
c. Low Risk level (L) work increased to 18 job risks. Because after risk control was carried out, the Medium Risk level decreased or was reduced to a Low Risk level, which means that the increase in the Low Risk level is the result of a decrease in the Moderate Risk level.

Based on the results above, all jobs that experience a decrease in the risk level after risk control is carried out are good for the company and for the workforce. A decrease in the High-Risk level has decreased to a Moderate Risk level, does not mean that work safety is completely safe. Because in this case there is still work that could be detrimental to workers and companies. Therefore, any work, no matter how small, must always be supervised so as not to cause work accidents.

Table 6. Risk Assessment Parameter Matrix After Control

Probability		Severity: Not Significant (1)	Low (2)	Moderate (3)	High (4)	Extreme (5)
Almost Certain	5	M	H	E	E	E
	4	Hit by a vehicle that was loading and unloading	M	H	E	E
Often Occurs	3	Tire burst	Brakes not working	M	H	E
	2	Oil leaks, Damaged or malfunctioning control levers, Exposure to sunlight and dust	Cargo transport vehicles that exceed capacity	Collision with another vehicle	M	H
Can Occur	1	There is a material spill, extreme weather, overloaded cargo	Steep slope, Officers exposed to hazardous chemicals	L	L	M

Source: Data Analysis Results (2024)

Information:

E	= Ekstreme Risk
H	= High Risk
M	= Moderate Risk
L	= Low Risk

Then from the 21 levels of risk after control which have been analyzed from the HIRARC table and if converted into percentages, the results obtained from the assessment after control have been carried out are as follows:

$$R = \frac{Total\ Risk}{Total\ Overall\ Risk} \times 100\%$$

$$\text{High Risk} = \frac{0}{21} x\ 100\% = 0\%$$

$$\text{Moderate Risk} = \frac{2}{21} x\ 100\% = 9{,}5\ \%$$

$$\text{Low Risk} = \frac{18}{21} x\ 100\% = 86{,}5\ \%$$

From the results of the risk assessment after risk control was carried out, the percentage form above shows that the High-Risk work level got a percentage of 0%, the Moderate Risk work level got a percentage of 9.5% and the Low Risk level got a percentage of 86.5%.

Figure 3. Comparison of risk levels before and after control

Based Figure 3, the level of hazard risk in each job before the control was carried out decreased after the risk control was carried out. So, from the results of the data that has been analyzed, by carrying out control is a very important effort to maintain work safety.

Risk Control

Risk control is an effort to assist companies in the risk identification process to reduce or minimize work accidents. Risk control is carried out so that every risk that has the potential for danger is reduced to a safe point [15]. Risk control has an important role in HIRARC to reduce the level of risk of danger by considering the hierarchy of risk control, namely, elimination, substitution, engineering, administration and personal protective equipment. The following risk control actions based on the hierarchy of hazard control can occur at any time:

1. Elimination - modifying the design to eliminate hazards; for example, introducing mechanical lifting devices to eliminate manual handling of hazards.
2. Substitution - substituting less hazardous materials or reducing system energy (for example, reducing power, amperage, pressure, temperature, etc.).
3. Engineering / design controls - installing ventilation systems, guard machines, interlocks, etc.
4. Administrative controls - safety signs, hazardous area signs, photo-luminescent signs, signs for pedestrian walkways, warning sirens / lights, alarms, safety procedures, equipment inspections, access controls, safe systems, markings, and work permits, etc. Administrative control measures are those who carry out work in accordance with the Standard Operating Procedure (SOP) that has been set by the company, such as the implementation of the placement of K3 signs in places that have the potential to be dangerous, and direct supervision from HSE such as, workers attending K3 briefings after changing shifts or before carrying out operations, operator training, operators must have SIO (Operator License), health checks before operating equipment, socialization of the impact of environmental pollution, provision of safe speed limits.
5. Personal Protective Equipment (PPE) - safety glasses, hearing protection, face shields, respirators, and gloves, safety shoes. The use of personal protective equipment is carried out to prevent / reduce the severity if a work accident occurs. Personal protective equipment is provided to loading and unloading workers in the field.

Actions and Handling in the Event of an Accident During Loading and Unloading of Vehicles on the MV. Aishakamilah

Supervision related to occupational safety and health such as ensuring that all workers wear personal protective equipment when working under heavy equipment. Supervision carried out by K3 implementers at PT. Bumi Lintas Tama in accordance with Law No. 1 of 1970 concerning occupational safety. Supervision carried out directly by PT. Bumi Lintas Tama workers is also running, such as conducting direct visits/direct observations in the field of all potentially dangerous objects, carrying out controls to reduce the impact of these hazards, patrolling field conditions

and reprimanding several workers who do not comply with SOPs for occupational safety and health. Then the reporting and handling actions if a work accident or accident occurs in the field are:

1. First, make a report on the accident and then report it to the Assistant Manager of Service Operations,
2. Second, the report is submitted to the K3 supervisor to investigate the cause so that improvements can be made.

CONCLUSION

Based on Identification using the Hazard Identification, Risk Assessment and Determining Control (HIRADC) method, the identified hazards in the loading and unloading process at PT. Bumi Lintas Tama, there are 21 identified hazards. Low Risk hazards (low risk) have 13 potential hazards, namely exposure to sunlight, climbing and descending stairs, hot weather factors, spilled materials, ship tilt, broken lashing ropes, damaged radiators, rainy weather, dusty roads, tallymen not wearing gloves, tallymen not wearing helmets, quality control tripping over lashing ropes, and high ship ramp doors. After that, there is also a Moderate Risk level (moderate risk) there are 6 potential hazards including being hit by vehicles, being caught by vehicles when installing lashing ropes, cargo falling into the sea, uneven roads, slippery roads, and burst vehicle tires. As for High Risk (high risk) there are 2 potential hazards, namely brakes not working and being hit by other vehicles.

The results of the risk assessment obtained from the total of 21 identified hazards from the loading and unloading process activities on the MV. Aishakamilah at the Car Terminal of PT. Bumi Lintas Tama, there are results from the risk level after control, namely the High-Risk level of 0 risks, the Moderate Risk level of 3 and the Low Risk level of 18 risks. From the observations made by researchers in the field, the loading and unloading process at PT. Bumi Lintas Tama has 4 risk control hierarchies applied. The risk controls applied are substitution, engineering, administration, and personal protective equipment.

From the results of the study, a way was obtained to reduce the level of risk of danger in vehicle loading and unloading operations on the MV. Aishakamilah, namely by conducting a briefing before carrying out loading and unloading activities and always paying attention to PPE in working and paying attention to the applicable SOP.

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REFERENCES

[1] B. Swastika, P. A. Wibowo, and Z. Abidin, “Pengaruh keselamatan dan kesehatan kerja (K3) terhadap produktivitas kerja karyawan,” *Jurnal Ilmu Kesehatan Masyarakat*, vol. 11, no. 02, pp. 197–204, 2022.

[2] J. D. Fairussihan, “Analisis Risiko Keselamatan Dan Kesehatan Kerja (K3) Pada Proses Perbaikan Kapal di PT. Dock Dan Perkapalan Surabaya Menggunakan Metode Hirarc (Hazard Identification, Risk Assessment, And Risk Control),” *Hexagon*, vol. 3, no. 1, pp. 10–16, 2022.

[3] G. A. A. Bangun and W. Hariyono, “Analisis Penerapan Keselamatan dan Kesehatan Kerja (K3) Pada Kapal Penumpang di PT PELNI Semarang,” in *Seminar Dan Konferensi Nasional IDEC*, 2019, pp. 1–6. Accessed: Dec. 06, 2024. [Online]. Available: https://idec.ft.uns.ac.id/wp-content/uploads/2019/05/ID099.pdf

[4] R. I. Putera and S. Harini, “Pengaruh Keselamatan Dan Kesehatan Kerja (K3) Terhadap Jumlah Penyakit Kerja Dan Jumlah Kecelakaan Kerja Karyawan Pada Pt. Hanei Indonesia,” *Jurnal Visionida*, vol. 3, no. 1, pp. 42–53, 2017.

[5] F. Saputra and M. R. Mahaputra, “Building occupational safety and health (K3): Analysis of the work environment and work discipline,” *Journal of law, politic and humanities*, vol. 2, no. 3, pp. 105–114, 2022.

[6] N. Faizah and E. Purnamawati, “analisis risiko k3 pada kegiatan reparasi kapal dengan menggunakan metode Hazard Identification, Risk Assessment and Determining Control (HIRADC) dan metode Job Safety Analysis (JSA) pada PT. NF,” *JUMINTEN*, vol. 2, no. 5, pp. 74–85, 2021.

[7] D. P. Putra, “Penerapan inspeksi keselamatan dan kesehatan kerja sebagai upaya pencegahan kecelakaan kerja,” *HIGEIA (Journal of Public Health Research and Development)*, vol. 1, no. 3, pp. 73–83, 2017.

[8] M. B. Saputro and M. Basuki, “Risk Assessment K3 Pada Divisi Kapal Niaga Pt. Pal Indonesia Menggunakan Metode Fmea (Failure Mode and Effect Analysis),” *Jurnal Sumberdaya Bumi Berkelanjutan (SEMITAN)*, vol. 1, no. 1, pp. 203–213, 2022.

[9] H. H. P. Daulay, *Islamic education in the national education system in Indonesia*. Jakarta: Kencana, 2014.

[10] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D*. Bandung: CV Alfabeta, 2021.

[11] A. A. Athqiya, D. N. Haqi, P. A. Alayyannur, I. Paskarini, and F. M. Sugiharto, “Hazard identification, risk assessment, and determining controls in laboratories,” *Indian Journal of Public Health Research & Development*, vol. 10, no. 7, pp. 877–883, 2019.

[12] D. F. Hidayat and J. Hardono, “Penerapan Metode HIRADC pada Bagian Proses Penerimaan di PT. CA,” *Journal Industrial Manufacturing*, vol. 6, no. 2, pp. 87–92, 2021.
[13] R. Fauziah, P. A. Alayyannur, D. N. Haqi, and S. Hidayat, “Hazard Identification, Risk Assessment, and Determining Control (HIRADC) Method in a University Laboratory in Surabaya, Indonesia.,” *Indian Journal of Forensic Medicine & Toxicology*, vol. 14, no. 1, 2020, Accessed: Dec. 06, 2024. [Online]. Available: https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09739122&AN=148347395&h=DEQHFIvW7HerVO5ATRQpNQ%2Bd%2FyMYgJV5Jn%2FSFRhQ7WdGTdPPrdnH2LlLrvoI2Ny3%2B8VvQ4w2iV%2B7gGsYpKbogA%3D%3D&crl=c
[14] M. R. Lazuardi, T. Sukwika, and K. Kholil, “Analisis manajemen risiko keselamatan dan kesehatan kerja menggunakan metode HIRADC pada departemen assembly listrik,” *Journal of Applied Management Research*, vol. 2, no. 1, pp. 11–20, 2022.
[15] A. C. Ahmad, I. N. M. Zin, M. K. Othman, and N. H. Muhamad, “Hazard identification, risk assessment and risk control (HIRARC) accidents at power plant,” in *MATEC Web of Conferences*, EDP Sciences, 2016, p. 00105. Accessed: Dec. 13, 2024. [Online]. Available: https://www.matec-conferences.org/articles/matecconf/abs/2016/29/matecconf_ibcc2016_00105/matecconf_ibcc2016_00105.html