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Risk Management Using the HIRARC Method at the PT ASDP Pulau Baai Ferry Port, Bengkulu Province

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ABSTRACT

The Baai Island Ferry Port serves a pioneer route from Baai Kahyuapu Island, a distance of 106 miles, with a travel time of approximately 13 hours using the KMP Pulo Tello. Observations indicate non-compliance with Standard Operating Procedures (SOPs) regarding the use of Personal Protective Equipment (PPE) during loading and unloading of goods and passengers, potentially leading to the risk of work accidents. This study used the*HIRARC*to identify, assess, and analyze work risks referring to the Regulation of the Minister of Manpower and Transmigration Number PER.08/MEN/VII/2010 concerning Personal Protective Equipment (PPE). The results of the study revealed various potential hazards, such as slipping, being hit by a vehicle, falling into the sea, transportation accidents, and exposure to hazardous materials (fuel and toxic vapors). The SOP is expected to be a guideline for all parties involved in port operations to minimize risks and improve work safety, especially in the loading and unloading of passengers and goods at KMP Pulo Tello.

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1. INTRODUCTION

Transportation is one part of the system that plays an important and strategic role in the mobility of passengers, goods and services both within the country and to and from abroad. Ports are also an important part of economic activities in the Indonesian region because they advance the transportation and logistics chain system.[1].

River, Lake and Ferry Transportation (ASDP) is a vital transportation service to support inter-island connectivity and is operated efficiently and sustainably to ensure passenger safety and comfort as well as protect the aquatic environment with the aim of improving connectivity, equitable development, and reducing disparities in access between regions. River, Lake and Ferry Transportation (ASDP) is seen as a key link in the national transportation network to improve community welfare and develop the economy in water areas by facilitating ferry transportation activities with the presence of ports.

Occupational Safety and Health (K3) is one of the things that needs special attention, because if this is ignored, accidents experienced by workers will result in a decrease in the quality of work carried out by the workers themselves, thus potentially leading to high work risks being experienced.[2]This is useful for identifying potential hazards in loading and unloading activities at the PT ASDP Bengkulu Branch ferry port pier. The benefits of this research include providing ideas in the field of occupational safety, especially in

transportation activities at the Pulau Baai pier, and as information and input for the community and related agencies to improve the safety of ferry transportation at the pier. The government and the community around the Pulau Baai pier can understand the importance of passenger and service provider safety in the transportation process, and can reduce the risk of work accidents at the pier.[3].

This research is useful for identifying potential hazards in loading and unloading activities at the Pulau Baai ferry dock, Bengkulu. The benefits of this research include providing suggestions for Occupational Safety and Health (K3), particularly in waterway activities at Pulau Baai Port, and providing input for the surrounding community and relevant agencies in improving occupational safety and health (K3) in ferry transportation at the Port.[4]. And the government and coastal communities around Pulau Baai Port can learn about the importance of passenger safety and security in the crossing transportation process, and can minimize the risk of work accidents at Pulau Baai Port.[5].

Based on the results of observations made by researchers, the potential hazards and risks of work carried out in the process of loading and unloading passengers using the shunting process at the Baai Island Ferry Port, Bengkulu Province, which are caused by the existence of a port channel that cannot be passed by the KMP Pulo Tello ship to enter the port pool, so the process of loading and unloading passengers is carried out offshore using a shunting system in the process of unloading, this can cause the potential for work accidents during the shunting process which is caused by a lack of awareness and use of Personal Protective Equipment (PPE) for each crew member, therefore there must be more extra observation and understanding from the relevant officers so that there is no risk of work accidents resulting from the negligence of the KMP Pulo Tello crew.

Therefore, the author made this problem the object of research and became an urgency that needs to be considered and immediately provided an alternative solution in the form of Standard Operating Procedures (SOP). The Standard Operating Procedures (SOP) can bind and regulate examiners to always use complete Personal Protective Equipment (PPE) in the implementation of loading and unloading. So the researcher hopes that after the preparation of the Standard Operating Procedures (SOP), loading and unloading at the port can improve work safety by using complete Personal Protective Equipment (PPE). Thus, the researcher is interested in compiling a Mandatory Working Paper (KKW) with the title "Risk Management Using the Method*HIRARC* At the PT ASDP Pulau Baai Ferry Port, Bengkulu Province"

2. RESEARCH METHODS

This research is a quantitative research. Quantitative is a research method that uses data in the form of numbers or information that can be measured statistically. This study began for 4 months, from February to June. The research location was on Jl. Ir. Rustandi Sugianto, Padang Serai, Kp. Melayu District, Bengkulu City (PT. ASDP Bengkulu Branch).

Research instruments are tools for collecting, processing, analyzing and presenting data systematically and objectively with the aim of solving a problem or testing a hypothesis. [4]. Using a questionnaire as a supporting tool to collect data for research. Conducting a study requires a data source that can address the research problem. Obtaining the necessary data from a concrete and reliable source can determine the quality of the research results. This study utilized two types of data sources: primary and secondary data.

Primary data is data obtained through initial observations on loading and unloading of passengers and goods on the KMP Pulo Tello ship before the Standard Operating Procedure (SOP) for Personal Protective Equipment (PPE) was in place. Work risk identification was then carried out using the HIRARC method through interviews and filling out questionnaires with work safety equipment involved in each loading and unloading on the KMP Pulo Tello ship at the Port of PT ASDP Bengkulu Branch. Meanwhile, secondary data is data obtained indirectly and used to support primary data. The secondary data is in the form of Article 1 Paragraph 1 of the Regulation of the Minister of Manpower No. 5 of 2018 concerning Occupational Safety and Health. Regulation of the Minister of Manpower and Transmigration No. Per.08 / Men / VII / 2010 concerning PPE. PM 50 of 2017 which is used as a reference for preparing Standard Operating Procedures (SOP) within the Ministry of Transportation.

The data collection methods used in this study were observation and interviews. Observation techniques are a way or method of collecting information or data by systematically observing and recording the phenomena being observed.[6]Through observation, researchers observed and recorded activities carried out in the dock area related to the preparation and implementation of occupational safety, particularly focusing on the use of Personal Protective Equipment (PPE). Researchers will conduct focused observations on the risks of workplace accidents and the causes of each Occupational Safety and Health (K3) tool used for loading and unloading passengers and goods.

An interview is described as a technique carried out through a conversation between two parties to obtain desired information from one of the parties asking questions in the interview. The interview method applied is a guided interview. Before conducting the interview, the author created a framework of questions that would help them obtain information to support the research. After designing the questions, the researcher will ask these questions to workers through a questionnaire. This includes as a method or way to collect research data by utilizing a written question form submitted to the PT ASDP Port Branch of Bengkulu to obtain information and answers.

A questionnaire was also submitted to the port to obtain their opinion regarding the questions that had been prepared which generally included an assessment of hazard risks identified from the results of field observations. For example, loading and unloading carried out by ship operators and port operators use personal protective equipment in accordance with existing Standard Operating Procedures (SOP) for safety reasons which are assessed based on the level of likelihood and severity and categorized into several groups. The following is the classification of the HIRARC method as stated inTable1.

Table1. Risk Assessment Classification

Risk Level	Score	Information
Low	1 - 4	Monitoring to ensure that control procedures are in place
Moderate	5 - 11	Management responsibility must be implemented
High	12 - 16	Needs to get management's attention and corrective action
Extreme	>16	Immediate control is needed

This research data analysis used quantitative descriptive analysis techniques with the HIRARC (Hazard Identification, Risk Assessment, and Risk Control) approach. This analysis was conducted through three main stages: Hazard Identification, Risk Assessment, and Risk Control. Once control measures are implemented, it is important to continuously monitor their effectiveness and conduct periodic evaluations. This is to ensure that the control measures remain effective and to identify potential improvements.

3. RESULTS AND DISCUSSION

3.1. Existing Port Conditions

3.1.1. Existing Geographical Conditions of the Region

Pulau Baai Port is geographically strategic—facing the Indian Ocean and serving as a key regional export/logistics hub. However, environmental conditions such as heavy sedimentation, coastal erosion, and high waves have caused significant channel siltation, seriously impacting port operations. Dredging is underway to preserve its functionality and restore economic connectivity to Pulau Baai.

Port At Pulau Baai Port, there are crossing facilities and infrastructure. The transportation facilities available at the crossing at Pulau Baai Port, Bengkulu, have 1 ship managed by PT. ASDP Indonesia Ferry, Bengkulu Branch, which serves the Bengkulu-Enggano route with a distance of approximately 156 km or 90 nautical miles with an estimated normal sea journey of approximately 12 hours. Port infrastructure at Baai Port includes the PT. ASDP Indonesia Ferry Bengkulu Branch Office, passenger ticket counters, a ready-to-load parking lot, a passenger waiting room, a prayer room, and toilets.

Water facilities are available to support safe and efficient ship traffic, berthing, loading and unloading, and maneuvering. Facilities at Pulau Baai Port include gangways, plengsengan piers, bollards, fenders, catwalks, and trestles. All of these facilities serve to ensure the smooth operation of ships and the safety of passengers and cargo during loading and unloading. Furthermore, the physical condition and maintenance of these facilities are crucial factors in maintaining sustainable port service standards.

3.1.2. Existing Conditions of Port Productivity

Based on productivity data on passenger and vehicle arrivals and departures over the past five years (2020–2024) on the Pulau Baai–Kahyapu route, a significant growth trend is visible across nearly all categories. This increase reflects the increasing mobility of people and the intensity of goods flow through the port, along with growing economic activity and interregional connectivity.

Based on the last five years of departure productivity data at Pulau Baai Port, a significant upward trend in the number of adult passengers is visible, from 3,459 in 2020 to 8,156 in 2024. The child category also experienced fluctuations, but generally tended to increase, with the highest peak in 2023 at approximately 400 passengers. For vehicles, the groups with the most significant growth were Class 2, from 570 units in 2020 to 1,328 units in 2024, and Class 5B, which increased from 592 units to 1,170 units in the same period. Some vehicle classes, such as Class 1 and Class 9, remained relatively low, although they showed slight increases in recent years. This indicates that the large two-wheeled vehicle segment and public passenger vehicles are more

dominant in departures than other vehicle types. This increase is also likely influenced by improvements in service quality, route promotion, and the growth of the tourism and trade sectors in the destination areas.

Arrival productivity data also shows an upward trend in line with departures. Adult passengers increased from 2,678 in 2020 to 5,504 in 2024, while child passengers fluctuated, peaking at 888 in 2023. Within the vehicle category, Class 2 and Class 5B dominated arrivals, with a consistent upward trend, reaching 781 and 695 units, respectively, in 2024. Several other classes, such as Class 6B, 7, and 9, experienced lower arrival numbers but showed a positive trend towards the end of the period. This indicates that, despite variations between classes, overall arrival flows at the port have experienced fairly stable growth. This growth indicates the growing role of Pulau Baai Port as a maritime transportation hub supporting goods distribution, passenger movement, and regional economic development.

3.2. HIRARC Method Risk Analysis

3.2.1. Hazard Risk Identification

Risk analysis and risk mitigation in fertilizer loading and unloading activities at the PT ASDP Bengkulu Branch dock. Risk data processing using the HIRARC method was carried out based on the loading and unloading activities of shunter passengers at the dock obtained through direct observation by researchers. Activities recorded in the HIRARC method cover the entire process, from the port to the ship. This process begins by identifying risks associated with the recorded activities. Next, risk assessment and risk control are carried out to reduce potential hazards in each type of work.

After registering all activities carried out by the crew in the dock area, the initial stage of risk management using the HIRARC method is to identify the risk factors obtained from direct observation of worker activities. Based on the observation results, five types of work accident risks were identified that could be experienced by crew members, namely being struck by objects during work, slipping or falling, being hit by work aids, muscle injuries due to repetitive work activities, and excessive noise exposure that can cause permanent hearing loss. These five risks include events that can cause physical injury and long-term health problems if not properly anticipated. Therefore, risk identification is a crucial stage in determining appropriate control measures, such as the use of Personal Protective Equipment (PPE), the implementation of safe work procedures, and increasing awareness and safety training for crew members, thereby minimizing the possibility of work accidents and improving operational safety in the port environment.

The loading and unloading activities of the KMP Pulo Tello vessel identified at this stage included inspections of technical requirements and seaworthiness during sailing. In addition to field observations used to reinforce the risk identification stage, the researchers also conducted interviews with the KMP Pulo Tello crew, resulting in 19 interviews. Accident risk identification at the research location was conducted at:Table2.

Table2. Identification of Work Accident Risks

No	Activity	Code	Hazard's findings description	Risk of danger
1.	Loading and Unloading of Passenger Ships and Vehicles	A.1	Slip, Trip, and Fall	Minor injury to injury heavy
		A.2	Hit or Run Over by a Vehicle	Serious injury
		A.3	Fall into the Sea	Drowning to serious injury
		A.4	Heavy Equipment or Transport Accidents	Crushed to the point of serious injury
2.	Workplace Accident While Disembarking Passengers on a Ship	B.1	Physical Injury While Assisting an Elderly or Special Needs Passenger	Muscle injury
		B.2	Crushed by Passenger's Luggage	Minor injuries to bruises
		B.3	Hit or Crushed by Vehicle/Transportation	Serious injury

No	Activity	Code	Hazard's findings description	Risk of danger
		B.4	Crowd or Push of Passengers	Minor injuries to serious injuries
3.	Workplace Accident During Ship Bunkering Process	C.1	Fuel Spill	Fuel vapor poisoning
		C.2	Toxic Fume Exposure	Respiratory tract irritation
		C.3	Short Circuit or Electrical Interference	Burns
		C.4	Fuel Contamination	Shortness of breath, dizziness and nausea

Based on the occupational accident risk identification table, there are three main categories of potential hazards on the KMP Pulo Tello: occupational accidents during passenger shunting, and occupational accidents during the ship's bunkering process. Each category carries a variety of risks, ranging from minor injuries to serious injuries and even potential death, such as slipping, being hit by a vehicle, falling overboard, being crushed by objects, being trapped by a conveyance, and crowding with passengers. Furthermore, during the ship's bunkering process, the dangers of fuel spills, exposure to toxic vapors, electrical short circuits, and fuel contamination have been identified, which can cause poisoning, respiratory irritation, burns, and shortness of breath. This identification serves as an important basis for determining risk management priorities, so that prevention and control measures can be designed appropriately.

3.2.2. Hazard Risk Assessment

OHSAS 18001:2007 requires companies to establish, implement, and maintain procedures to identify hazards, assess risks, and establish necessary controls. Based on the risk assessment, actions are determined for each hazard to the crew by establishing likelihood and severity criteria. The results of the researchers' observations were presented in the form of a questionnaire to the crew to assess the likelihood and severity if the risk were to occur. The following are the evaluation results:Table2.

Table3. Results of service quality evaluation based on physical parameters and facilities

No	Activity	Code	Hazard's findings description	Risk of Danger	L	C	L x C
1.	Loading and Unloading of Passenger Ships and Vehicles	A.1	Slip, Trip, and Fall	Minor injuries to serious injuries	5	4	20
		A.2	Hit or Run Over by a Vehicle	Serious injury	4	2	8
		A.3	Fall into the Sea	Drowning to serious injury	4	5	20
		A.4	Heavy Equipment or Transport Accidents	Crushed to the point of serious injury	4	5	20
2	Workplace Accident While Disembarking Passengers on a Ship	B.1	Physical Injury While Assisting an Elderly or Special Needs Passenger	Muscle injury	4	2	8
		B.2	Crushed by Passenger's Luggage	Minor injuries to bruises	5	3	15
		B.3	Hit or Crushed by Vehicle/Transportation	Serious injury	5	5	25
		B.4	Crowd or Push of Passengers	Minor injuries to serious injuries	4	1	4
3	Workplace Accident During Ship Bunkering Process	C.1	Fuel Spill	Fuel vapor poisoning	4	2	8
		C.2	Toxic Fume Exposure	Respiratory tract irritation	5	3	15

No	Activity	Code	Hazard's findings description	Risk of Danger	L	C	L x C
		C.3	Short Circuit or Electrical Interference	Burns	4	3	12
		C.4	Fuel Contamination	Shortness of breath, dizziness and nausea	4	2	8

After the assessment is carried out, the value of each activity can be determined by using the code in the hazard findings description as follows:

a. Loading and Unloading of Passenger Ships and Vehicles
   1) A1 = 20
   2) A2 = 8
   3) A3 = 20
   4) A4 = 20
b. Workplace Accident While Disembarking Passengers on a Ship
   1) B1 = 8
   2) B2 = 15
   3) B3 = 25
   4) B4 = 4
c. Workplace Accident During Ship Bunkering Process
   1) C1 = 8
   2) C2 = 15
   3) C3 = 12
   4) C4 = 8

After that, a hazard risk ranking is performed. This stage is carried out to determine the priority level for mitigation of incidents, accidents, and hazards that could arise from a work accident. Risk ranking is based on the total score obtained for each potential hazard risk given by the respondents. The following is the hazard ranking for each hazard risk.Table2.

Table4. Hazard Risk Ranking

No	Activity	Code	Hazard's findings description	Risk of Danger	L	C	L x C	Rank
1.	Loading and Unloading of Passenger Ships and Vehicles	A.1	Slip, Trip, and Fall	Minor injuries to serious injuries	5	4	20	2
		A.2	Hit or Run Over by a Vehicle	Serious injury	4	2	8	7
		A.3	Fall into the Sea	Drowning to serious injury	4	5	20	2
		A.4	Heavy Equipment or Transport Accidents	Crushed to the point of serious injury	4	5	20	2
2	Workplace Accident While Disembarking Passengers on a Ship	B.1	Physical Injury While Assisting an Elderly or Special Needs Passenger	Muscle injury	4	2	8	5
		B.2	Crushed by Passenger's Luggage	Minor injuries to bruises	5	3	15	2
		B.3	Hit or Crushed by Vehicle/Transportation	Serious injury	5	5	25	1
		B.4	Crowd or Push of Passengers	Minor injuries to serious injuries	4	1	4	5

3	Workplace Accident During Ship Bunkering Process	C.1	Fuel Spill	Fuel vapor poisoning	4	2	8	3
		C.2	Toxic Fume Exposure	Respiratory tract irritation	5	3	15	1
		C.3	Short Circuit or Electrical Interference	Burns	4	3	12	1
		C.4	Fuel Contamination	Shortness of breath, dizziness and nausea	4	2	8	1

The hazard risk rankings were obtained from the assessments given by respondents through a questionnaire. Based on these results, hazard risks ranked 1 include B3 (being hit or crushed by a vehicle/transportation), C2 (exposure to toxic vapors), C3 (short circuit or electrical disturbance), and C4 (fuel contamination). Hazard risks ranked 2 include A1 (slipping, tripping, or falling), A3 (falling overboard), A4 (accidents involving vehicles or heavy equipment), and B2 (being crushed by passenger luggage). Meanwhile, hazard risks ranked 3 are C1 (fuel spills).

Hazards ranked 5 include B1 (physical injury while assisting elderly or disabled passengers) and B4 (crowding or crushing of passengers). A hazard ranked 7 is A2 (being hit or run over by a vehicle). This ranking helps determine risk control priorities based on severity and likelihood of occurrence.

3.2.3. Hazard Risk Control

Controlling the potential hazards that could occur during the loading and unloading of the KMP Pulo Tello. The benefit of this stage is that the crew understands the steps they need to take to control occupational risks. The following is a summary.Table2.

Table5. Risk Control

No	Activity	Code	Hazard's findings description	Risk of Danger	Risk Control
1.	Loading and Unloading of Passenger Ships and Vehicles	A.1	Slip, Trip, and Fall	Minor injuries to serious injuries	Use of complete PPE, especially helmets, safety shoes, gloves and masks. Maintain a safe distance from vehicles.
		A.2	Hit or Run Over by a Vehicle	Serious injury	
		A.3	Fall into the Sea	Drowning to serious injury	
		A.4	Heavy Equipment or Transport Accidents	Crushed to the point of serious injury	
2	Workplace Accident While Disembarking Passengers on a Ship	B.1	Physical Injury While Assisting an Elderly or Special Needs Passenger	Muscle injury	Use of complete PPE, especially helmets, safety shoes and gloves
		B.2	Crushed by Passenger's Luggage	Minor injuries to bruises	
		B.3	Hit or Crushed by Vehicle/Transportation	Serious injury	
		B.4	Crowd or Push of Passengers	Minor injuries to serious injuries	
3	Workplace Accident During Ship Bunkering Process	C.1	Fuel Spill	Fuel vapor poisoning	Use complete PPE, especially helmets, safety shoes, gloves and masks.
		C.2	Toxic Fume Exposure	Respiratory tract irritation	

No	Activity	Code	Hazard's findings description	Risk of Danger	Risk Control
		C.3	Short Circuit or Electrical Interference	Burns	
		C.4	Fuel Contamination	Shortness of breath, dizziness and nausea	

After classifying risk controls, a risk matrix is then mapped, depicting the assessment classifications given by respondents to a hazard. The results of this risk matrix mapping will determine whether a risk is classified as extreme, high, moderate, low, or very low. The following classifications are available:Table2.

Table6. Hazard Risk Ranking

Possibility/Consequences	Not Significant (1)	Small (2)	Currently(3)	Big(4)	Disaster (5)
Almost Certain (5)					
Very Possible (4)				C1, C4	
Possible (3)			A1, B2, C2, B1		C3
Impossible(2)			B4	A4, A3	
Seldom (1)		A2, B3			

Based on the risk matrix table above, it can be seen that each combination of likelihood and consequence levels results in a different risk classification. Risks coded C1 and C4 fall into the "Very Likely" probability category with "Disastrous" consequences, thus categorizing them as extreme risks requiring immediate control. Risks A1, B2, C2, and B1 fall into the "Possible" probability category with "Moderate" to "Major" consequences, thus categorizing them as high risk. Meanwhile, risks coded A2, B3, and B4 fall into the "moderate" to "low" risk category, thus categorizing them as low risk.

4. CONCLUSION

Based on the results of research conducted at the Bengkulu Branch of PT ASDP Port, several conclusions can be drawn, namely the identification of hazard risks in the loading and unloading of passengers and goods on the KMP Pulo Tello ship, such as slipping, being hit by a vehicle, falling overboard, and exposure to hazardous materials such as fuel vapors. These risks arise from non-compliance with the use of Personal Protective Equipment (PPE) and the lack of strict implementation of Standard Operating Procedures (SOPs).

As well as the hazard risk assessment using the HIRARC Method (Hazard Identification, Risk Assessment, and Risk Control) as a basis to reveal that the highest risks are in the high to extreme categories, especially in activities involving heavy equipment, exposure to chemicals, and unstable work environment conditions.

In the final section, there is hazard risk control as a recommended mitigation effort, including the preparation of clear Standard Operating Procedures (SOPs), regular work safety training, and the complete and disciplined use of Personal Protective Equipment (PPE) by all workers.

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