Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)
Vol. 11 No.2, April 2025
P-ISSN : 2407-8441/e-ISSN : 2502-0749

Original Research Paper

Analysis of Potential Hazards with Job Safety Analysis Techniques at Filling Stations and Transportation of Bulk LPG – PT. Tambang Yokodelta North Sulawesi

Aprillya Arikalang*, Arlin Adam, Sudirman Sanuddin, Zamli

Master Of Public Health Science Study Program, Mega Buana University Palopo

Email Corresponding:
aarikalang@gmail.com

Page : 179-187

Keywords:
Job Safety Analysis, Occupational Risk, LPG Station, PPE, Risk Control

Article History:
Received: 2024-09-22
Revised: 2024-11-25
Accepted: 2025-04-30

Published by:
Tadulako University,
Managed by Faculty of Medicine.
Email: healthytadulako@gmail.com
Phone (WA): +6285242303103
Address:
Jalan Soekarno Hatta Km. 9. City of Palu, Central Sulawesi, Indonesia

ABSTRACT

Background: The LPG Bulk Filling and Transportation Station (SPPBE) at PT. Tambang Yokodelta Matungkas, North Minahasa, is a high-risk environment due to the flammable and pressurized nature of LPG. Identifying potential hazards is essential to ensure worker safety and prevent accidents. **Objective:** This study aims to analyze potential hazards and assess occupational risks using the Job Safety Analysis (JSA) method at the SPPBE of PT. Tambang Yokodelta. **Methods:** This qualitative research involved interviews and observations with eight informants, including the SPPBE manager, HSE head, technicians, and operators. Data were collected through interviews, field observations, and document review, and analyzed descriptively. **Results:** The study identified hazards classified into four risk levels: Low, Medium, High, and Extremely High. Low-risk activities, such as minor injuries, can be controlled with personal protective equipment (PPE). Medium risks, like falling during LPG handling, require additional PPE. High risks, including fire hazards during gas filling, need engineering controls. Extremely high-risk activities, such as gas explosions, require immediate management action and substitution measures. **Conclusion:** Workers at PT. Tambang Yokodelta face various risks. Effective control measures, including PPE, SOP compliance, engineering controls, and management commitment, are crucial for ensuring occupational safety.

Introduction

Occupational Safety and Health (OSH) is a fundamental aspect of any work environment, aimed at protecting workers from accidents and occupational diseases. It is not only a legal and moral responsibility of companies but also a strategic element that influences employee performance and overall organizational productivity[1,2].

The successful implementation of OSH programs has been linked to increased employee motivation and productivity. Zebua et al[3]. highlighted that well-implemented OSH programs enhance workers' motivation, while other studies affirm the positive correlation between OSH practices and workforce productivity[4,5]. Thus, OSH plays a crucial role in operational efficiency and the achievement of organizational goals[6].

Despite its recognized importance, the implementation of Occupational Health and Safety Management Systems (OHSMS) in many industries, particularly in the construction and energy sectors, remains inadequate. This gap is often attributed to low awareness, insufficient supervision, lack of training, and poor risk evaluation mechanisms[7,8,9,10]. Research by Putri and Lestari[7] identifies human error, the use of inappropriate tools, and failure to follow safety protocols as the primary causes of workplace accidents.

To address these issues, the Job Safety Analysis (JSA) method has emerged as a widely used and effective tool in hazard identification and risk mitigation. JSA involves

breaking down a job into individual tasks to systematically assess potential hazards and determine control measures for each step[1,11,12]. According to a systematic review by Ghasemi et al.[13], JSA remains one of the most practical tools in occupational risk assessment. However, its application is sometimes hindered by limited documentation, lack of worker participation, and infrequent updating of assessments.

Numerous studies have demonstrated the effectiveness of JSA in various work environments. For example, JSA has been applied in metal casting processes[12], mechanical tasks in power plant projects[14], and palm oil grading operations[15], significantly reducing the risk of accidents. Additionally, JSA has proven valuable in environments involving complex and high-risk machinery, such as laser cutting equipment[16], where it contributes to enhanced operational safety.

In Indonesia, the use of JSA in industrial settings is growing, yet many organizations still face challenges in integrating it consistently into daily operations. Studies also show that comprehensive JSA implementation demands cross-functional collaboration and continuous worker engagement [17,18,19].

Given the high-risk nature of activities involving the filling and transportation of bulk liquefied petroleum gas (LPG), especially at PT. Tambang Yokodelta North Sulawesi, hazard identification through JSA is crucial. These operations involve flammable materials, high-pressure systems, and potentially explosive environments, which necessitate rigorous safety protocols.

This study, therefore, aims to identify potential hazards and evaluate occupational risks in the filling and transportation of bulk LPG at PT. Tambang Yokodelta using the Job Safety Analysis (JSA) technique. The findings are expected to contribute actionable recommendations for enhancing workplace safety and preventing future occupational accidents.

Materials and Methods

Research Design

This study employed a qualitative research approach using an in-depth interview design to explore and analyze potential hazards associated with the filling and transportation of bulk LPG. The qualitative method was selected to enable a comprehensive understanding of safety practices and hazard perceptions from multiple perspectives within the operational environment. This approach allows for a deeper exploration of human experiences, behaviors, and interpretations related to occupational safety.

Sample

The sample in this study consisted of eight key informants who were selected using purposive sampling techniques. This approach was chosen to ensure that individuals with the most relevant knowledge and direct experience regarding workplace safety and operational procedures were included. The informants comprised the LPG Bulk Filling and Transportation Station Manager, the Head of the Occupational Health and Environmental Protection Subdivision (K3LL), two technicians, and four operators. These individuals were deliberately selected because of their critical roles in the day-to-day operations and their responsibility in implementing and maintaining safety protocols at the facility. Their insights were deemed essential in identifying potential occupational hazards, assessing associated risks, and evaluating the effectiveness of existing control measures. By focusing on this group, the study aimed to gather comprehensive and contextually rich data that could accurately reflect the safety conditions and risks present in

the LPG filling and transportation work environment.

Data Collection Techniques

Data collection was carried out using two primary methods: in-depth interviews and observations. The in-depth interviews were conducted with all eight participants to gather detailed information about the processes, potential hazards, and safety measures implemented during the filling and transportation of bulk LPG. Interviews were semi-structured, allowing for flexibility in exploring emerging themes. Observation was conducted on-site to validate and complement the information obtained from interviews, particularly regarding workplace practices, safety protocols, and employee behavior. Additionally, document reviews were used as a secondary data source, including safety manuals, standard operating procedures (SOPs), and previous incident reports to support triangulation and enhance data validity.

Data Analysis Techniques

The collected data were analyzed using descriptive qualitative analysis. The data were first transcribed and then organized thematically based on emerging patterns related to hazard identification and safety practices. These themes were categorized and interpreted to provide a structured understanding of the risk factors and control mechanisms in place. The analysis emphasized narrative descriptions supported by quotations from informants and observational findings, enabling a holistic presentation of the research results. To ensure the credibility and trustworthiness of the findings, data triangulation was applied by cross-verifying information from interviews, observations, and document reviews, thereby enhancing the rigor of the analysis.

Ethical Considerations

Although formal ethical clearance was not sought due to the nature of the study and organizational internal review protocols, this research was conducted with high ethical standards. Informed consent was obtained from all participants prior to interviews, and they were assured of the confidentiality and anonymity of their responses. The participants were informed about the purpose of the research and their right to withdraw at any time without any consequences. Data were used solely for research purposes, and no identifiable information was included in the reporting to protect participant privacy.

Results

Informant Characteristics

The study involved eight informants who were employees at the LPG Bulk Filling and Transportation Station of PT. Yokodelta. The detailed characteristics of the informants are presented in Table 1. All informants were male, with ages ranging from 29 to 50 years. The length of service varied, with one informant having worked for 3 years, two informants working approximately 4 to 5 years, and the others ranging up to 5 years. Regarding education, three informants had completed senior high school, one had a bachelor's degree, and two held master's degrees.

Job Safety Analysis Observation

Observations and hazard identification related to LPG filling and transportation activities were conducted, with results summarized in Table 2. Three main job tasks were analyzed: (1) LPG cylinder handling at SPPBE, (2) LPG gas filling, and (3) LPG cylinder distribution. For each task, potential hazards, possible consequences, risk levels, current control measures, and suggested improvements were identified.

The table highlights multiple hazards categorized by their severity (S) and likelihood

(L) to generate a risk matrix. Among the hazards, tube explosions and fires present the highest risks, often classified as extreme or high, requiring urgent and careful management. The existing control measures such as the use of personal protective equipment (PPE), masks, and procedural checks are in place, but additional suggestions, like improved handling techniques and enhanced protective gear, were recommended to further mitigate risks.

Table 1. Informant Characteristics

Informan	Age (Year)	Gender	Position	Length of Service	Education
M.S	50	Male	SPPBE Manager	3 Year	Master's degree
J.M	48	Male	Sub Head of HSE	4 Year	Master's degree
N.K	43	Male	Technician	5 Year	Bachelor's degree
T.K	39	Male	Technician	4 Year	Senior high school
D.P	32	Male	Operator	3 Year	Senior high school
I.R	29	Male	Operator	3 Year	Senior high school
A.S	32	Male	Operator	3 Year	Senior high school
R.R	33	Male	Operator	4 Year	Senior high school

Table 2. Hazard Identification and Job Safety Analysis

No	Job	Potential Hazards or Injuries	Consequences	Risk Matrix			Matrix Analysis	Controls Executed	Suggestion
				S	L	Rk			
1	LPG cylinder drop to SPPBE	a. Tube explosion	a. Permanent disability to the body and even death	5	E	H	H	1. Move the LPG cylinder by lifting it. 2. Held tightly	Moving LPG cylinders by lifting with two hands or using a trolley
		b. Gas poisoning	b. Gastrointestinal disorders and even lung disease	4	C	E	E	Using a mask	
		c. Falling on the tube	c. Minor injuries to the body	1	E	L	L	Use PPE when doing work	
2	LPJ gas filling	a. Gas poisoning	a. Gastrointestinal disorders and even lung disease	4	C	E	E	Using a mask	
		b. Fire	b. Resulting in permanent disability or death	5	E	H	H	1. Check filling hall is safe 2. Check filling machine unit is working properly 3. Check valve	Setting up fire extinguishers
3	LPG cylinder distribution	a. Falling on the tube	a. Minor injuries to the body	1	E	L	L	Use PPE when doing work	
		b. Falls during transportation of LPG cylinders	b. Experiencing impact	2	C	M	M	Use PPE when doing work	Wear a helmet and safety shoes
		c. Tube explosion	c. Permanent disability of the body and even death	5	E	H	H	Laying the tube carefully	
		d. Gas poisoning	d. Gastrointestinal disorders and even lung disease	4	C	E	E	Using a mask	
		e. Fire	e. Resulting in permanent disability or death	5	E	H	H	Place the LPG cylinder carefully	

The table highlights multiple hazards categorized by their severity (S) and likelihood (L) to generate a risk matrix. Among the hazards, tube explosions and fires present the highest risks, often classified as extreme or high, requiring urgent and careful management. The existing control measures such as the use of personal protective equipment (PPE), masks, and procedural checks are in place, but additional suggestions, like improved handling techniques and enhanced protective gear, were recommended to further mitigate risks.

Risk Matrix Analysis

The overall risk values of potential hazards across all work areas are summarized in Table 3, which cross-references likelihood and consequence levels. The matrix uses five categories for both likelihood (from almost certain to rare) and consequence (from insignificant to catastrophic) to rank hazards from low (L) to extreme (E) risk.

Based on the risk matrix, there are two low-risk hazards primarily involving minor injuries that can be effectively managed with PPE. One hazard was categorized as medium risk, such as falls during transportation, requiring enhanced protective measures including helmets and safety shoes.

Four hazards were classified as very high risk, notably tube explosions and fires, which demand immediate attention and strict control protocols to prevent severe injury or death. Specifically, three hazards tube explosion during cylinder handling and distribution, and fires during gas filling and distribution were identified as requiring urgent intervention from top management to ensure safety compliance and effective risk mitigation.

These results underscore the critical importance of continuous hazard identification and risk assessment, combined with practical safety measures and management commitment to protect workers in the LPG filling and transportation processes.

Table 3. Matrix of Potential Hazard Risk Values for Workers in All Work Areas.

Likeli-hood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catasthropic**
	1	**2**	**3**	**4**	**5**
A (almost)	H	H	E	E	E
B (likely)	M	H	H	E	E
C (moderate)	L	3B	H	1B/2A/3D	E
D (unlikely)	L	L	M	H	E
E (rate)	1C/3A	L	M	H	1A/2B/3C/3E

Description

1A : Tube Explosion
1B : Gas Poisoning
1C : Struck by Tube
2A : Gas Poisoning
2B : Fire
3A : Crushed by a tube
3B :Fall during transportation of ellipiji tube
3C : Tube explosion
3D : Gas poisoning
3E : Fire

Discussion

This study analyzed potential hazards at the LPG Bulk Filling and Transportation Station (SPPBE) of PT. Tambang Yokodelta in North Minahasa using the Job Safety Analysis (JSA) method. Data were collected between April and June 2024 through interviews with key personnel, including the SPPBE Manager, Head of Occupational Health and Safety (K3LL), technicians, and operators. The JSA provided a systematic approach to identify

hazards and assess risks associated with LPG handling, filling, and distribution activities. Similar studies in industrial settings emphasize the importance of JSA in proactively preventing occupational accidents by identifying and mitigating workplace hazards[20,21].

For tasks identified as low-risk, such as the possibility of minor injuries from being hit by an LPG tube, the study findings confirm that the use of complete personal protective equipment (PPE), including gloves and protective clothing, effectively reduces injury rates. This aligns with previous research highlighting the critical role of PPE in safeguarding workers against common physical hazards in industrial environments[22]. However, PPE alone is not sufficient; adherence to proper handling procedures is also necessary to minimize exposure and injury risks[23].

Medium-risk tasks, such as falls during transportation of LPG cylinders, require more comprehensive control measures. In addition to wearing complete PPE, including safety shoes and helmets, adherence to Standard Operating Procedures (SOPs) is crucial to prevent accidents. The findings support prior evidence that combining PPE with strict procedural compliance significantly reduces occupational injuries in logistics and manual handling operations[24]. Training workers to recognize risks and follow SOPs can enhance safety culture and reduce the incidence of falls and related injuries[25,26].

High-risk tasks identified in this study, such as LPG cylinder handling and gas filling operations that involve risks of explosions and fire, demand stringent safety controls. Use of complete PPE and strict adherence to SOPs are critical, but these must be complemented by technical controls such as regular equipment maintenance, fire safety installations, and emergency response plans. This multifaceted approach is supported by international safety standards and best practices that emphasize engineering controls alongside PPE to effectively manage severe hazards[27,28].

For hazards categorized as extremely high risk, immediate and decisive actions by top management are imperative to ensure worker safety. These include continuous risk monitoring, enforcement of safety policies, provision of adequate resources for hazard control, and fostering a safety-first organizational culture. Research consistently shows that management commitment and leadership play a pivotal role in successful occupational health and safety programs[29,30]. Without top management support, even well-designed safety measures may fail to prevent serious workplace accidents.

Conclusion

The findings of this study indicate that workers at the LPG Bulk Filling and Transportation Station (SPPBE) of PT. Tambang Yokodelta Matungkas, North Minahasa, face a very high level of occupational accident risk across all job areas. The identified hazards span a full spectrum of risk categories, including low, medium, high, and extremely high risk levels. Effective control measures to mitigate these risks should follow the hierarchy of risk control: for low-risk tasks, the use of personal protective equipment (PPE) is sufficient to manage potential hazards. Medium-risk tasks require the use of complete PPE, supplemented with safety shoes and helmets to enhance protection. High-risk activities demand engineering controls, such as machine safeguarding and work reorganization, alongside additional worker protections during the LPG filling process. For extremely high-risk tasks, substitution control methods replacing hazardous materials or processes with safer alternatives are recommended to minimize danger.

Based on these results, it is suggested that PT. Yokodelta management re-evaluate the current application and provision of PPE to

ensure that it adequately meets the intensity of worker exposure to hazardous tasks. Additionally, routine maintenance of equipment and infrastructure should be strictly implemented to prevent occupational hazards related to mechanical failure. The establishment of an on-site health clinic is also recommended, serving as a critical resource for immediate first aid and ongoing health monitoring to effectively manage and reduce the impact of workplace accidents.

Acknowledgments

The authors would like to express their sincere gratitude to the management and staff of PT. Tambang Yokodelta Matungkas, North Minahasa, for their support and cooperation during the data collection process. We also thank all informants who willingly participated and shared valuable insights that contributed to this study.

References

1. Muhammad Zulfi Ikhsan. Identifikasi Bahaya, Risiko Kecelakaan Kerja Dan Usulan Perbaikan Menggunakan Metode Job Safety Analysis (JSA). *Jurnal Teknologi dan Manajemen Industri Terapan*. 2022;1(I):42-52. doi:10.55826/tmit.v1ii.13
2. Tarrwaka. Keselamatan Dan Kesehatan Kerja. Published online 2012.
3. Zebua E, Telaumbanua Y, Lahagu A, Suka Adil Zebua E, Telaumbanua E, Lahagu A. Pengaruh Program Keselamatan Dan Kesehatan Kerja TerhadapMotivasi Kerja Karyawan Pada Pt. Pln (Persero) Up3 Nias. *Jurnal EMBA*. 2022;10(4):1417-1435.
4. Swatika B, Wibowo PA, Abidin Z. Pengaruh Keselamatan dan Kesehatan Kerja (K3) Terhadap Produktivitas Kerja Karyawan. *Jurnal Ilmu Kesehatan Masyarakat*. 2022;11(02):197-204. doi:10.33221/jikm.v11i02.1220
5. Hidayatullah A, Tjahjawati SS. Pengaruh Keselamatan dan Kesehatan Kerja Terhadap Produktivitas Kerja Karyawan. *Jurnal Riset Bisnis dan Investasi*. 2018;3(2):104. doi:10.35697/jrbi.v3i2.938
6. June S, Siagian M. Pengaruh Keselamatan Dan Kesehatan Kerja Dan Lingkungan Kerja Terhadap Kinerja Karyawan Pt Lautan Lestari Shipyard. *Jurnal Apresiasi Ekonomi*. 2020;8(3):407-420. doi:10.31846/jae.v8i3.325
7. Putri DN, Lestari F. Analisis penyebab kecelakaan kerja pada pekerja di proyek konstruksi : Literatur review. *Jurnal Kesehatan Masyarakat*. 2023;7(1):451-452.
8. Novita W, Rini E, Aswin B. Ketenagakerjaan Cabang Jambi. *Jmj*. 2020;(Spesial Issues):62-86.
9. Syafrial H, Ardiansyah A. Prosedur Keselamatan Dan Kesehatan Kerja (K3) Pada PT. Satunol Mikrosistem Jakarta. *Abiwara : Jurnal Vokasi Administrasi Bisnis*. 2020;1(2):60-70. doi:10.31334/abiwara.v1i2.794
10. Kurnia MB. Faktor-Faktor Penyebab Rendahnya Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja (SMK3) pada Perusahaan Bidang Pekerjaan Konstruksi. *Jurnal Student Teknik Sipil*. 2020;2(2):141-146.
11. Aristriyana E, Ferdian D. Identifikasi Potensi Bahaya Menggunakan Metode Job Safety Analysis Pada Konveksi Cv. Jasa Karya Nusantara Banjarsari. *Jurnal Industrial Galuh*. 2023;4(1):1-11. doi:10.25157/jig.v4i1.3008
12. Mukti Mulyojati PA, Yuamita F. Analisis Potensi Bahaya Kerja Pada Proses Pencetakan Pengecoran Logam Menggunakan Metode Job Safety Analysis (JSA). *Jurnal Teknologi dan Manajemen*

Industri Terapan. 2023;2(2):90-97. doi:10.55826/tmit.v2i2.141

13. Ghasemi F, Doosti-Irani A, Aghaei H. Applications, Shortcomings, and New Advances of Job Safety Analysis (JSA): Findings from a Systematic Review. *Safety and Health at Work*. 2023;14(2):153-162. doi:10.1016/j.shaw.2023.03.006
14. Balili S, Yuamita F. Analisis Pengendalian Risiko Kecelakaan Kerja Bagian Mekanik Pada Proyek PLTU Ampana (2x3 MW) Menggunakan Metode Job Safety Analysis (JSA). *Jurnal Teknologi dan Manajemen Industri Terapan*. 2022;1(2):61-69. doi:10.55826/tmit.v1iii.14
15. Firdaus A, Yuamita F. Upaya Pencegahan Kecelakaan Kerja Pada Proses Grading Tbs Kelapa Sawit Di PT. Sawindo Kencana Menggunakan Metode Job Safety Analysis (JSA). *Jurnal Teknologi dan Manajemen Industri Terapan*. 2022;1(3):155-162. doi:10.55826/tmit.v1iiii.40
16. Palega M. Application of the job safety analysis (jsa) method to assessment occupational risk at the workplace of the laser cutter operator. *Management and Production Engineering Review*. 2021;12(3):40-50. doi:10.24425/mper.2021.138529
17. Situngkir D, Rusdy MDR, Ayu IM, Nitami M. Sosialisasi Keselamatan Dan Kesehatan Kerja (K3) Sebagai Upaya Antisipasi Kecelakaan Kerja Dan Penyakit Akibat Kerja (Pak). *JPKM : Jurnal Pengabdian Kesehatan Masyarakat*. 2021;2(1):64-72. doi:10.37905/jpkm.v2i1.10242
18. Lazuardi MR, Sukwika T, Kholil K. Analisis Manajemen Risiko Keselamatan dan Kesehatan Kerja Menggunakan Metode HIRADC pada Departemen Assembly Listrik. *Journal of Applied Management Research*. 2022;2(1):11-20. doi:10.36441/jamr.v2i1.811
19. Walujodjati E, Rahadian SP. Analisis Manajemen Risiko K3 Pekerjaan Jalan Tol Cisumdawu Phase III. *Jurnal Konstruksi*. 2021;19(1):60-69. doi:10.33364/konstruksi/v.19-1.874
20. Sugarindra M, Suryoputro MR, Novitasari AT. Hazard Identification and Risk Assessment of Health and Safety Approach JSA (Job Safety Analysis) in Plantation Company. *IOP Conf Ser: Mater Sci Eng*. 2017;215:012029. doi:10.1088/1757-899X/215/1/012029
21. Ghasemi F, Doosti-Irani A, Aghaei H. Applications, Shortcomings, and New Advances of Job Safety Analysis (JSA): Findings from a Systematic Review. *Safety and Health at Work*. 2023;14(2):153-162. doi:10.1016/j.shaw.2023.03.006
22. Dewantari NM, Ferdiansyah M, Herlina L, Mariawati AS, Umyati A. Risk analysis and safety measures: JSA, HIRA, and FTA in LPG distribution. *JISS UNTIRTA*. 2023;9(2):247. doi:10.36055/jiss.v9i2.21847
23. OSHA. Personal Protective Equipment. *Occupational Safety and Health, US Department of Labor*. Published online 2023.
24. Friend MA, Kohn JP. *Fundamentals of Occupational Safety and Health*. 4. ed. Government Institutes; 2007.
25. Salmawati L, Ar B. Analisis Risiko Kesehatan dan Keselamatan Kerja dengan Menggunakan Metode Hazard Identification, Risk Assessment and Risk Control (HIRARC) pada Area Produksi PT. Chungsung Kota Palu. 2017;3(1).
26. Bautista-Bernal I, Quintana-García C, Marchante-Lara M. Safety culture, safety performance and financial performance. A

longitudinal study. *Safety Science*. 2024;172:106409. doi:10.1016/j.ssci.2023.106409

27. Disrinama AM. Studi Analitis Penurunan Forced Expiratory Volume in 1 Second pada Pekerjaan Penyelam. *Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)*. 2020;6(1):13-20.
28. Taylor G, Easter K, Hegney R, Taylor GA. *Enhancing Occupational Safety and Health*. Elsevier Butterworth-Heinemann; 2004.
29. O. ALLI B. Fundamental principles of occupational health and safety. *Choice Reviews Online*. 2002;39(07):39-3997-39-3997. doi:10.5860/CHOICE.39-3997
30. Murnane L. Risk Management Practices in the Fire Service. *FEMA*. Published online 2018.