International Journal of Eco-Innovation in Science and Engineering (IJEISE) Vol.06 (2), 2025 (78-85)
https://ijeise.upnjatim.ac.id/ E-ISSN: 2721-8775

Article

Risk Analysis of Temporary Storage of B3 Waste at PT. PLN (Persero) Main Unit of Transmission in Eastern Java and Bali to the Environment with the Method *Failure Mode and Effect Analysis* (FMEA)

Asti Meilinda Sari [1,a], **and Restu Hikmah Ayu Murti** [1,b*]

[1]Department of Enviromental Engineering Faculty of Engineering and Science, Universitas Pembangunan Nasional Veteran Jawa Timur, Surabaya 60294, Indonesia

E-mail: [a]22034010025@student.upnjatim.ac.id, [b]restu.hikmah.tl@upnjatim.ac.id
*Corresponding author: (restu.hikmah.tl@upnjatim.ac.id) | Phone number: +6283138146194

Received: 08th May 2025; Revised: 28th May 2025; Accepted: 23rd June 2025;
Available online: 30th November 2021; Published regularly: May and November

Abstract

The type of waste that is classified as hazardous and toxic (B3) has characteristics that can cause environmental damage if its management is not carried out safely and according to procedures. The temporary storage facility for B3 waste owned by PT PLN (Persero) East Java and Bali Transmission Main Unit needs special attention so as not to create environmental risks around it. This study aims to identify and assess potential risks in the B3 waste storage area in the company through the FMEA (Failure Mode and Effect Analysis) method. The FMEA method is used to determine the possible failures that can occur in the B3 waste storage system and evaluate the impact it has on the environment. The results of the analysis showed that some failures, such as storage container leaks and ventilation system damage, have a high potential risk associated with soil and water pollution. This risk assessment provides recommendations for improving and strengthening B3 waste management, including improving monitoring and maintenance procedures of storage facilities, as well as improving training for staff involved in waste management. It is hoped that with the implementation of the results of this analysis, it can reduce the potential risks and environmental impacts caused by B3 waste management at PT. PLN (Persero) Main Unit of Transmission in East Java and Bali.

Keywords: Risk, B3 Waste, Temporary Storage, FMEA, Environment

1. Introduction

B3 waste has a very different source and characteristics compared to other wastes, namely unstable, reactive, explosive, flammable, and toxic characteristics [1]. B3 waste from industrial activities has the potential to pollute the environment if disposed of without treatment, and this can have a negative impact on the sustainability of living things, including humans [2]. As stated in Government Regulation of the Republic of Indonesia No. 22 of 2021 concerning Environmental Management and Protection, every business actor is obliged to carry out environmental responsibility through the control and management of operational activities that have the potential to have an impact [3]. Therefore, the increase in industrial activities

DOI:10.4186

needs to be balanced with environmental impact management and responsible waste management [4].

Every industry has the potential to produce waste that contains toxic and hazardous substances, such as heavy metals, cyanide, pesticides, paints, dyes, oils, solvents, and other high-risk chemicals. If the waste is not treated properly, the impact on the environment can be much more severe than other types of waste [5]. Every company is required to achieve excellence over its competitors by reducing potential risks that can hinder operational performance [6] . Risk is an uncertain condition and has the potential to cause harm or loss, both from ongoing and potential future activities [7]. The type of risk can include environmental aspects, work system failures, and threats to labor health and safety, so the implementation of risk management strategies is crucial to identify vulnerable points and prevent losses with appropriate control [8].

PT. PLN (Persero) East Java and Bali Transmission Main Unit is a company engaged in the transmission of electric power. This industry supports the provision of energy for various sectors, such as infrastructure, transportation technology, as well as household and industrial activities [9]. PT. PLN (Persero) East Java and Bali Transmission Main Unit distributes electricity through modern transmission networks, quality equipment, and competent human resources, Temporary storage of B3 waste comes from the maintenance and repair of the electricity transmission network, office operations, and management of supporting facilities [10]. Based on the UUPLH, B3 waste that cannot be managed related to production activities can be handed over to a third party that provides B3 waste treatment services and has established cooperation with related industries [11].

This study uses the Failure Mode and Effect Analysis (FMEA) approach to evaluate the environmental impact of B3 waste temporary storage activities at PT PLN (Persero) East Java and Bali Transmission Main Unit, because this method is able to identify potential damage, causes, and effects that may arise based on a number of parameters such as severity, occurrence, and detection effectiveness [12]. The Risk Priority Number (RPN) value was obtained from the FMEA analysis to determine the order of priorities in handling risks, so that mitigation strategies can be focused on risks with the highest level of urgency to reduce negative impacts and improve the operational efficiency of B3 waste TPS facilities [13].

The main objective of this study is to assess the various risks that arise in the process of managing B3 waste temporary storage facilities at PT PLN (Persero) East Java and Bali Transmission Main Unit, especially related to their impact on the environment. The FMEA method is commonly applied in manufacturing and engineering to identify potential failures of systems and product components. However, in this study, the approach was modified and applied specifically to analyze the potential environmental risks arising from B3 waste storage activities. This approach is relatively not widely used in the electricity transmission sector, especially in the context of managing waste temporary storage facilities.

Through the FMEA approach, this study seeks to identify potential failure points in the waste management system, analyze the consequences caused, and determine the level of risk through the calculation of the Risk Priority Number (RPN). Through this analysis, it is hoped that appropriate mitigation priorities and strategic recommendations can be set to improve the management of B3 waste landfills to be safer, more efficient, and more environmentally friendly. The results of this research are expected to support environmental sustainability and ensure compliance with applicable regulations..

2. Material and Method

Before conducting a study related to the temporary storage location of B3 waste at PT. PLN (Persero) of the Main Unit of Transmission for East Java and Bali, a literature review was held first. The study includes information on B3 waste, characteristics, and principles of temporary storage. The next step is data collection after a literature review [14]. The data collection methods applied include direct observation, literature study, and Failure Mode and Effect Analysis (FMEA). The data obtained consisted of secondary data and primary data [15]. Primary data is collected by considering knowledge related to the type of B3 waste, the origin of B3 waste, its characteristics, and the estimated amount of B3 waste that will be

DOI:10.4186

produced. Primary data collection is carried out using various approaches, including:

2.1 Field Observation

The analysis process was carried out by conducting direct field observations of the B3 waste storage building managed by PT PLN (Persero) East Java and Bali Transmission Main Unit. All activities and locations of B3 waste storage in the TPS building area were comprehensively documented as part of the observation process to support the validity of the data.

2.2 Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis (FMEA) is used as a tool to assess the possibility of failures in system elements, processes, and technical components that have the potential to hinder the achievement of preset targets. This method helps identify risks and understand how failures can affect the success of the design[16].

The Risk Priority Number (RPN) is the result of risk evaluation obtained from the results of multiplying the value of severity (S), probability of occurrence (O), and detection ability (D) of each potential failure.

Severity (S) x *Occurrence* (O) x *Detection* (D) = Risk Priority Number (RPN). The *Severity* (S), *Occurrence* (O) and *Detection* (D) assessment categories are available in Table 1, Table 2 and Table 3.

Table 1. Description of the *Severity* scale in FMEA

Value Scale *Severity*				
1	2	3	4	5
Very Small	Small	Keep	Big	Very Large
Risks do not impact the environment or human activities	Minimal environmental risk without significant impact on industry	The risk has a real impact on the environment and has little impact on the industry	Risks have a major impact on the environment and severely disrupt industrial activities	Risks have serious impacts on the environment, people, and long-term industrial activities

Environmental Condition Scale				
1	2	3	4	5
Excellent	Good	Keep	Bad	Very bad
Ideal conditions that are desired to be achieved and have no effect on the environment	Conditions that have the potential to pose environmental risks, but are still in the safe category	The emerging risks are starting to have an impact on the environment, but they remain within the	Condition make The onset of risks can lead to critical to the soil, water, air, flora & fauna around	Conditions are far from safe standards and have the potential to cause serious damage to the

Table 2. Limitations of the Occurrence value criteria in the FMEA

Rating	*Occurrence*	Probability of Risk *Occurrence*
1	Never	≤ 1 incident in 1 year
2	Infrequently	2-3 events in 1 year
3	Quite often	4-5 events in 1 year
4	Often	6-8 occurrences in one year
5	Very often	≥ 9 incidents in 1 year

Table 3. Limitations of the *Detection* value criteria in FMEA

Rating	*Detection*	Probability of Risk *Occurrence*
1	It's Very Easy	The supervision and control applied are very effective in detecting equipment damage and reducing the risk of environmental pollution

2	Easy	The control system has a good level of effectiveness in predicting damage and preventing environmental impacts
3	Enough difficult	The supervision carried out is quite helpful in estimating minor damage and small-scale environmental risks
4	Difficult	Control systems are not adequate to recognize potential equipment interference and environmental risks
5	Very difficult	There is no monitoring system to detect equipment damage or prevent the risk of environmental pollution

Secondary data that is used as a complement to support primary data functions in the process of analyzing the preparation of environmental documents. This document includes technical details related to the temporary storage location of B3 waste owned by PT. PLN (Persero) Main Unit of Transmission in East Java and Bali. Beriku t is the secondary data used, namely :

a. Laws and Regulations in Indonesia

Indonesia's B3 laws and regulations that regulate TPS LB3 in Government Regulation Number 22 of 2021 [17] and Regulation of the Minister of Environment and Forestry Number 6 of 2021 concerning how and conditions in the management of LB3 [18]. Meanwhile, the rules used for the use of symbols and tables of TPS B3 are PermenLHK RI No. 14 of 2013 concerning Symbols and Labels of Hazardous and Toxic Waste [19].

b. Previous Research Journals and Literature

The literature is used to review the results of previous research, including various findings relevant to the particular phenomenon or situation that the research is the focus of. Literature review in environmental documents is used to detail technical information regarding the location of the temporary B3 waste storage facility. The literature is taken from scientific journals and references to environmental documents. This study uses a literature review method with references taken from various journals and environmental documents.

Data collection was carried out to compile technical documents related to B3 waste storage facilities at PT PLN (Persero) East Java and Bali Transmission Main Unit, by analyzing logbook records. The controlled data is used to estimate the amount of B3 waste and determine the optimal B3 waste storage capacity. The determination of storage capacity is adjusted to the area available, in order to prevent the mixing of B3 waste types.

3. Results and Discussion

3.1 Characteristics of B3 Waste

PT. PLN (Persero) East Java and Bali Transmission Main Unit produces B3 waste from production, maintenance, and office activities. Limbah-limbah PT. PLN (Persero) East Java and Bali Transmission Main Unit has diverse characteristics and sources, with the amount of monthly B3 waste production also variing. Table 1. presents data on the characteristics of B3 waste types produced by PT PLN (Persero) East Java and Bali Transmission Main Unit East Java and Bali, as follows:

Table 4. Characteristics of LB3

No.	Waste Name B3	Waste Code B3	B3 Waste Source	Characteristics of B4 Waste	Total B3 Waste (kg/mo)
1	Waste containing POPs and UPOs compounds	A101d	Operational and/or maintenance activities	Toxic, Danger to the environment	50
2	Used Battery / Battery	A102d	Operational and/or maintenance activities	Harm to the environment	5
3	Other acidic wastes that	A109c	Operational and/or mainten	Corrosive	100

	have not been codified		ance activities		
4	B3-contaminated waste	A108d	Electrolyte acid water from wet cell battery operations	Harm to the environment	5
5	B3 Packaging	A104d	Operational and/or maintenance activities	Toxic, Danger to the environment	5
6	Used Lubricating Oil	B105d	Operational and/or maintenance activities	Flammable liquid	2000
7	Electronic Waste includes chatode ray tubes (CRTs), TL lamps, circuit board printes (PCBs), and metal wires	B107d	Operational and/or maintenance activities	Harm to the environment	2
8	Used Majun Fabric	B110d	Operational and/or maintenance activities	Harm to the environment	5
		Total			2172

Source : TPS LB3 Rintek Document PT. PLN (Persero) Main Unit of Transmission in East Java and Bali (2023).

The process of handling B3 waste is carried out by placing it first in the LB3 temporary storage facility (TPS) owned by PT PLN (Persero) of the Main Transmission Unit of East Java and Bali. After being stored temporarily, the B3 waste will be handed over to an external manager who has collaborated with the company and has a B3 waste management permit. However, the process of disposing of B3 waste to third parties can present potential problems in management policies, which can affect the sustainability of waste management in a good and healthy manner. Therefore, verification is needed in accordance with B3 waste management guidelines to prevent waste misuse, which can pose a significant risk to environmental pollution.

3.2 B3 Waste Storage Facility

B3 waste storage activities aim to accommodate hazardous and toxic waste for a limited period of time originating from the operations of PT PLN (Persero) East Java and Bali Transmission Main Unit. Some of the conditions for this storage include.

B3 waste storage is an activity to temporarily accommodate hazardous and toxic waste by the operational unit of PT PLN (Persero) of the Main Unit of Transmission in East Java and Bali. Some of the conditions for this storage include: protected from rain, ventilation system, waterproof flooring, appropriate labeling, strong packaging, sturdy cover, and clean packaging conditions.

The size of the B3 waste TPS building is 10 meters long, 3.5 meters wide, and 5.44 meters high. This TPS building is designed to accommodate B3 waste in a safe and organized manner in accordance with hazardous and toxic waste management standards. The location of the TPS building is at a geographical coordinate point with LS = 7° 20' 57.3" E = 112° 42' 30.3", which ensures the exact position is identified for effective management and supervision. This layout supports efficient waste management operations while meeting applicable safety and environmental requirements.

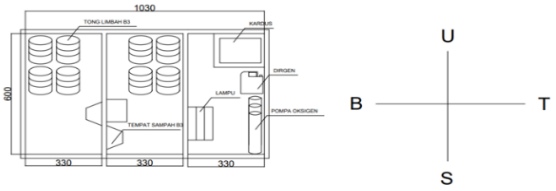

Fig. 1. Layout of the Arrangement of the Temporary Storage Place LB3 PT. PLN (Persero) Transmission Main Unit for East Java and Bali Source : Author 2025

3.3 Risk Assessment using FMEA

Researchers have assessed the severity (S), occurrence (O), and detectability (D) parameters in each of the identified risks. The calculation of the Risk Priority Number (RPN) for each risk is

carried out by multiplying the values of S, O, and D based on the results of direct observation in the field. This calculation is intended to determine the risk rating. Example of RPN calculation for environmental risk analysis of TPS LB3 at PT. PLN (Persero) East Java and Bali Transmission Main Unit is described in Table 5.

Table 5. Results of RPN Value Calculation of TPS LB3 Analysis

Unit	Potential Failure	Potential Impact of Failure	S	Cause	O	D	RPN
TPS LB3	The amount of waste exceeds the capacity of the TPS	The accumulation of B3 waste has an impact on soil and air pollution	2	Increased operational activity	2	2	8
	Mismatch SOUP B3 Waste Storage	B3 Waste Leakage Has an Impact on Soil, Water and Air Pollution	2	Lack of supervision and limited time and human resources	1	1	2
	Less waste cover condition strong	There is a splash /B3 Waste spill has an impact on soil, water and air pollution	2	Installation errors and inadequate cover design	2	1	4
	Officer's negligence	The storage location is beyond the reach of the B3 Waste manager due to the lack of monitoring	2	Limited supervision due to lack of time and adequate manpower	2	2	8
	Packaging type not according to the characteristics	Mixed waste triggers cross-contamination	4	Errors in packaging specifications and inconsistencies in the placement of B3 Waste	2	2	16
	Damage to the walls of the polling station	The fire occurred due to the TPS building made of flammable materials	1	Extreme environmental exposure and exposure to corrosive materials	1	1	1

Potential failures and their causes are analyzed by assigning weights to each failure based on severity, frequency of occurrence, and level of detection. These three values are then multiplied to obtain the Risk Priority Number (RPN) value. In this FMEA analysis, assessments for severity, occurrence, and detection were carried out using a scale of 1 to 5.

1) *Determination of Severity Value* (S)

Severity reflects the worst impact of a potential failure. The severity value is determined through the analysis of actual conditions based on observations, interviews, and comparisons of ideal conditions. In the assessment system, the safest conditions get the lowest severity score, which is 1, which will increase as the level of impact increases. The severity scale in this study was compiled based on factors that have the potential to affect the LB3 TPS system and B3 waste. Details regarding the description of the severity scale can be seen in Table 1.

2) *Determination of Occurrence Value* (O)

Occurrence (O) refers to the estimated rate of occurrence or frequency of failures triggered by a particular cause (Rachman et al., 2016). The assessment of the occurrence (O) value in this study considers the number of occurrences of errors in B3 waste management at PT PLN East Java and Bali Transmission Main Unit. The determination of the occurrence (O) assessment limit can be seen in Table 2.

3) *Determination of Detection Value* (D)

Detection (D) assesses the extent to which the control system is able to identify the main cause of possible failure (Rachman et al., 2016). The detection value is determined by considering the occurrence rate; The more often

failures occur, the weaker the effectiveness of the control used.
References for detection assessments and their limitations can be found in Table 3.

4) Risk Priority Number (RPN)

After all severity, occurrence, and detection values are known, the RPN calculation can be carried out to review the TPS management system and B3 waste management. The Risk Priority Number (RPN) is calculated by multiplying the scores of three main factors: severity, occurrence, and detection (Rachman et al., 2016). Here is a mathematical equation to calculate the Risk Priority Number (RPN) value.

$$\text{RPN} = S \times O \times D \quad (1)$$

The results of the FMEA analysis can be seen in Table 5.

Based on the results of the FMEA, the biggest potential risk in the B3 Waste TPS system at PT PLN UIT East Java and Bali with an RPN of 16 is the mismatch between the type of packaging and the characteristics of B3 waste. When viewed from the severity aspect, these risks do not have a major impact on industrial operations or the surrounding environment. However, due to the fairly high frequency of occurrences, this risk results in a relatively large RPN value. Failure of packaging types that do not match the characteristics of B3 waste is a problem that is quite difficult to avoid because sometimes it experiences Limited Packaging Availability and in the handling process is still manual so that errors during the process of sorting or packing B3 waste still often occur.

The handling of these failures is carried out with special procedures to prevent further impacts, such as using suitable replacement containers and conducting inspections of waste packaging before the management and storage of B3 waste is carried out. According to the B3 waste management emergency procedure, any findings of non-conforming packaging must be reported and recorded by the K3L section. However, the results of interviews with K3L show that the incident was not recorded several times because it was quite frequent and on a relatively small scale.

3.4 Risk Mitigation of B3 Waste Storage at TPS LB3 PT. PLN (Persero) Transmission Main Unit for East Java and Bali

Risk Mitigation Based on the FMEA analysis that has been conducted, the top priority in corrective actions is determined by the highest RPN value. This mitigation aims to improve the quality of control in the storage of B3 waste in the company, as well as reduce the risk of environmental impacts that may arise from future failures. FMEA analysis shows that the mismatch of the packaging type with the B3 waste properties is the highest risk based on the RPN value. Inaccuracies in the selection of packaging for certain types of B3 waste lead to errors in waste placement. The impact is the potential for cross-contamination between wastes, which can trigger environmental contamination, both in water, soil, and air media.

The preventive measures taken are to cooperate with third parties to provide packaging according to the standards and characteristics of the B3 waste produced, as stipulated in the SOP. In addition, routine inspections and maintenance are carried out related to B3 waste storage activities to minimize failures and their impact on the environment in the B3 waste storage process at TPS LB3 PT. PLN (Persero) Main Unit of Transmission in East Java and Bali.

4. Conclusions

The results of the analysis show that one of the main problems in the management of B3 waste storage at TPS is the use of packaging that is not in accordance with the nature of the stored waste. From the process of identifying environmental risks at B3 waste storage facilities at PT PLN (Persero) East Java and Bali Transmission Main Unit, it was found that there is a potential for mixing between wastes that can cause pollution to water, soil, and air. Based on the mapping and risk assessment that has been carried out previously, several sources of hazards that need to be further addressed are found, relevant monitoring strategies in the future are proposed in the form of digitization and automation of work monitoring, routine updating of the FMEA matrix and working with external parties to ensure the availability of packaging in accordance with the characteristics of B3 waste.

Acknowledgement

The author expresses his gratitude to all parties at PT. PLN (Persero) East Java and Bali Transmission Main Unit for the assistance

provided in the research data collection process. The author also thanked the internship supervisor for the guidance and various valuable advice that had been given.

References

[1] Y. Ruslinda dan R. N. Permadi, "Timbulan, komposisi dan karakteristik sampah bahan berbahaya dan beracun (B3) pada sarana kesehatan," Dampak, vol. 15, no. 2, pp. 59–65, 2018.

[2] A. Nursabrina, T. Joko, dan O. Septiani, "Kondisi pengelolaan limbah B3 industri di Indonesia dan potensi dampaknya: Studi literatur," J. Ris. Kesehat. Poltekkes Depkes Bandung, vol. 13, no. 1, pp. 80–90, Aug. 2021.

[3] I. R. Wiryawan dan K. Pharmawati, "Evaluasi pengelolaan limbah B3 cair proses produksi pada industri manufaktur di PT. Z, Kota Bandung," J. Lingkung. dan Kesehat. Kerja, vol. 8, no. 2, pp. 132–142, 2024.

[4] R. B. Kuncoro, S. S. Dahda, dan E. Ismiyah, "Analisis risiko limbah cair pada unit effluent treatment berdasarkan sistem manajemen lingkungan menggunakan metode FMEA dan RCA di PT. Petrokimia Gresik," JUSTI (J. Syst. dan Tek. Ind.), vol. 2, no. 3, pp. 403–412, 2022.

[5] G. Firmansyah dan M. Mirwan, "Status kinerja pengolahan lingkungan hidup (SKPL) limbah B3 industri besi PT. X, Kota Sidoarjo," J. Tek. Lingkung., vol. 3, no. 1, pp. 85–96, 2025.

[6] B. Kurniawan, "Pengawasan pengelolaan limbah bahan berbahaya dan beracun (B3) di Indonesia dan tantangannya," Din. Gov.: J. Ilmu Adm. Negara, vol. 9, no. 1, pp. 12–20, 2019.

[7] F. Sulaiman, A. Ridwan, P. F. Ferdinant, dan B. Rofi, "Rancangan penilaian risiko limbah bahan berbahaya dan beracun (B3) dengan pendekatan Hazard Identification Risk Assessment (HIRA)," FLYWHEEL: J. Tek. Mesin Untirta, vol. 1, no. 1, pp. 44–51, 2019.

[8] Iswanto, Sudarmadji, dan A. Sutomo, "Timbulan sampah B3 rumahtangga dan potensi dampak kesehatan lingkungan di Kabupaten Sleman, Yogyakarta," J. Manusia dan Lingkung., vol. 23, no. 2, pp. 179–188, 2016.

[9] M. Z. P. Nugroho, "Penerapan lean manufacturing untuk meningkatkan kinerja procurement dengan analisa performance supplier pada kasus industri baja," Oper. Excell.: J. Appl. Ind. Eng., vol. 12, no. 2, pp. 169–176, 2020.

[10] E. Wardhani dan M. V. Rafianto, "Pengelolaan LB3 di Perusahaan Listrik Negara PUSHARLIS UP2 WIII Bandung," J. Rekayasa Hijau, vol. 5, no. 3, pp. 267–280, 2022.

[11] Kementerian Lingkungan Hidup, "Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup," Lembaran Negara RI, no. 32, pp. 1–100, 2009.

[12] Z. F. Cahyani dan D. P. Sari, "Risiko kegagalan proses produksi pada PDAM Surya Sembada Kota Surabaya," J. Manaj. Aset dan Infrastruktur, vol. 6, no. 1, pp. 54–62, 2022.

[13] M. D. Cahyono, "Efektivitas ukuran sampah organik sebagai pupuk kompos dengan metode PLA dan FMEA," J. Tek. Ind. Terintegrasi, vol. 7, no. 3, pp. 1468–1477, 2024.

[14] E. Wardhani dan D. Salsabila, "Analisis sistem pengelolaan limbah B3 di industri tekstil Kabupaten Bandung," J. Rekayasa Hijau, vol. 5, no. 1, pp. 15–26, 2021.

[15] M. Rusdi, "Strategi pemasaran untuk meningkatkan volume penjualan pada perusahaan genting UD. Berkah Jaya," J. Stud. Manaj. dan Bisnis, vol. 6, no. 2, pp. 83–88, 2019.

[16] Badan Standardisasi Nasional, Manajemen Risiko – Teknik Penilaian Risiko menurut SNI IEC/ISO 31010:2016, Jakarta: BSN, pp. 1–187, 2017.

[17] Pemerintah Republik Indonesia, "Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Perlindungan dan Pengelolaan Lingkungan Hidup," Lembaran Negara RI, no. 078487A, pp. 1–483, 2021.

[18] Menteri Lingkungan Hidup dan Kehutanan, "Peraturan Menteri LHK Republik Indonesia Nomor 6 Tahun 2021 tentang Tata Cara dan Persyaratan Pengelolaan Limbah B3," Berita Negara RI, no. 6, pp. 5–24, Apr. 2021.

[19] Menteri Lingkungan Hidup dan Kehutanan, "Peraturan Menteri LHK RI No. 14 Tahun 2013 tentang Simbol dan Label Limbah Bahan Berbahaya dan Beracun," Berita Negara RI, no. 14, pp. 1–13, 2013.