

Fire Risk Analysis as a Basis for Evaluation and Determination of Fire Extinguisher Types at Yogyakarta International Airport Terminal

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Article Info	ABSTRACT
Article History: Submitted: 12 August 2026 Revised : 14 August 2026 Accepted : 29 September 2026	The departure area of the airport terminal is a facility with a high density of passengers, operational activities, and the use of electronic equipment, so it has various potential fire risks. This study aims to analyze the level of fire risk based on hazard identification and the assessment of likelihood and severity, aiming to formulate recommendations for zoning mapping and determining the type of risk-based Portable Fire Extinguishers media in the departure area of the Yogyakarta International Airport Terminal. The research is a descriptive study with a semi-quantitative risk assessment approach through the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method. Data were analyzed using a risk matrix referring to KP Number 242 of 2017. The results showed that the tenant area had the highest risk level with the High category (4B), while the check-in area, waiting lounge, and retail area were in the Moderate category. The evaluation shows that Dry Chemical Powder is still effective, but its residue has an impact on public areas. It is recommended to use Clean Agent Portable Fire Extinguishers in the check-in area, waiting lounge, and retail area, and Wet Chemical Portable Fire Extinguishers in the tenant area.
Keywords: Airport terminal; fire extinguishing media; fire risk; hazard.	

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INTRODUCTION

The terminal area of Yogyakarta International Airport is a public space with high mobility and passenger density, with passenger traffic reaching 4,054,807 people per year, so any potential fire hazard needs to be managed through a systematic risk management approach. Portable Fire Extinguishers serve as an initial firefighting tool designed to control small fires before they grow larger [1]. However, inventory results show that the extinguishing media in the departure area is still dominated by the Dry Chemical Powder (DCP) type, accounting for 83.10% of the 148 installed units. Although DCP is effective for Class A, B, and C fires [2], its use in public spaces with high passenger density has the potential to cause mass panic due to dust clouds and corrosive residues that can damage electronic equipment and disrupt terminal services.

Previous studies have discussed fire risk analysis using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method on various objects, such as shipyards [3], educational buildings [4], airport apron areas [5], occupational safety of ARFF personnel [6], and active fire protection system planning in lecture buildings [7], as summarized in Table 1. These studies have provided methodological contributions to hazard identification and risk assessment, but none have integrated fire risk assessment results with suitability evaluations and zoning recommendations for fire extinguisher types specifically in airport terminal public areas characterized by high passenger density. This gap underlines the originality of this research, which integrates HIRARC-based risk assessment with the feasibility evaluation of existing fire extinguishers and the formulation of risk-based extinguishing media zoning recommendations for each terminal functional zone.

Based on this description, this study aims to: (1) analyze the level of fire risk in the departure area of Yogyakarta International Airport Terminal based on hazard identification as well as likelihood and severity assessments; and (2) formulate recommendations for zoning mapping and determining the type of risk-based fire extinguisher media in each zone to support passenger safety and the continuity of public services.

Table 1 Summary of Relevant Previous Research

No	Author/Year	Title	Method	Research Results	Gap to This Research
1	Giovanni, Fathimahhayati, & Pawitra (2023)	Risk Analysis of Occupational Health and Safety Using HIRARC Method	HIRARC in shipyard area	Dominant risk is low (77%) to very high (3%), control priority based on likelihood-severity	Has not integrated HIRARC with the evaluation of extinguishing media suitability at airport terminals
2	Paat, Tambas, & Umboh (2023)	Fire Risk Analysis (Case Study at De La Salle Catholic University Manado)	Building fire risk analysis	Human and technical factors as the main causes of fire, root causes become the basis for mitigation strategies	Has not linked risk analysis results with the evaluation and recommendation of fire extinguisher types
3	Marsya & Dyahjatmayanti (2024)	Hazard Identification and Risk Assessment in the Apron Area of Adi Soemarmo International Airport	Qualitative descriptive, airport risk management	8 potential risks: 6 high and 2 moderate	Focuses on the apron area (airside), has not touched the passenger terminal and its relation to extinguishing media
4	Chaerunnisa, Saleh, &	OHS Hazard and Risk Identification	HIRADC on personnel	5 low, 6 moderate, and 3 high risks identified	Focuses on ARFF personnel safety risks, has not

	Awaluddin (2022)	for the ARFF Unit at Sultan Hasanuddin Airport, Makassar	occupational safety		discussed structural fire risks in the terminal area
5	Maulana, Ashari, & Anindita (2024)	Fire Risk Assessment and Active Fire Protection System Planning for a Lecture Building in Jakarta	Fire Risk Assessment (FRA)	5 high-risk, 135 moderate, 11 low-risk rooms; after system planning all rooms became low risk	Focuses on fulfilling the number of building protection systems, has not tested the suitability of extinguishing media types based on risk characteristics

METHODS

This research is a descriptive study with a qualitative approach using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method, which is semi-quantitative in assessing risk levels. The semi-quantitative approach was chosen because it combines qualitative field data with likelihood and severity matrices referring to the risk management principles of the ICAO Doc 9859 Safety Management Manual [8] and the risk assessment matrix of KP Number 242 of 2017 [9].

Research subjects were determined through purposive sampling of four informants with authority, competence, and direct experience in fire safety management: the ARFF Maintenance Supervisor, ARFF Operation Chief, Avsec Terminal Protection, and Head Chef of the food and beverage tenant. The research object is the terminal departure area and the fire extinguishers used in the check-in, waiting lounge, tenant, and retail area zones.

Data collection techniques included direct observation of potential fire sources and fire extinguisher inventory, interviews using indicators derived from ICAO Doc 9859 and KP Number 242 of 2017, and field condition documentation. Data analysis was carried out through data reduction, then analyzed using the HIRARC method: hazard identification, risk assessment using likelihood (scale 1-5) and severity (scale A-E) values written in the risk index format per the Safety Risk Index convention [9] and risk control in the form of recommendations for fire extinguisher media types. Data credibility was strengthened through source and technique triangulation. The research was conducted at the Yogyakarta International Airport Terminal from October 2025 to February 2026.

RESULT AND DISCUSSION

This research was conducted in the departure area of the Yogyakarta International Airport Terminal, which has an area of 219,000 m² with a passenger density reaching 4,054,807 people per year and operational hours from 06:00 to 21:00 WIB. There are 53 tenants on the departure floor that become distribution points for high fire loads. The results of hazard identification in each observation zone are presented in Table 2.

Table 2 Hazard Identification

Area	Hazard Source	Fire Potential	Impact	Fire Class
Check In	Counter electrical installations and electronic equipment, flammable materials (passenger baggage)	Electrical short circuits and electronic equipment overheating	Rapid fire spread to baggage piles, passenger panic, service disruption	A, C

Waiting Lounge	Charging stations and synthetic interiors (chairs, carpets)	Overheating in electrical sockets and fires starting on furniture	Mass panic and respiratory distress due to smoke	A, C
Tenant (F&B)	Hot cooking oil (deep frying), electric stoves, and kitchen equipment	Oil flare-ups, electrical overloads, short circuits	Food contamination and tenant asset loss	A, B, C, K
Retail Area	Merchandise and decorative lights	Short circuits and display material fires	Retail asset damage and smoke in public areas	A, C

Based on this hazard identification, each area was then assessed for its risk level using likelihood and severity matrices referring to KP Number 242 of 2017 [9]. The risk assessment results are shown in Table 3.

Table 3 Risk Assessment

Area	Potential	Likelihood	Severity	Risk Index	Category
Check In	Short circuits in computers and passenger baggage buildup	3	C	3C	Moderate
Waiting Lounge	Electrical installation overheating and synthetic interior materials amidst high passenger density	3	C	3C	Moderate
Tenant (F&B)	Hot cooking oil flare-ups and the use of high-power electrical kitchen appliances	4	B	4B	High
Retail Area	Short circuits in electrical installations and product displays	2	C	2C	Moderate

The assessment results indicate that the food and beverage tenant area obtained the highest risk index, which is 4B with a High Risk category, while the Check In and Waiting Lounge areas obtained an index of 3C, and the Retail Area obtained an index of 2C, placing all three in the Moderate Risk category. The existing fire extinguisher inventory results showed a total of 148 units in the departure area, consisting of 123 Dry Chemical Powder (DCP) units or 83.10% of the total, with the remainder being CO2 units installed in the Check In, Waiting Lounge, and Retail Areas as additional protection for electronic equipment.

The likelihood value in the food and beverage tenant area was set at level 4 (Occasional) because cooking activities using hot oil and high-power electrical equipment occur continuously during operational hours, meaning the area interacts more frequently with fire hazard sources compared to other areas. The Check In and Waiting Lounge areas are at level 3 (Remote) because the hazard sources, such as electrical installations and charging stations, fluctuate, while the Retail Area is at level 2 (Improbable) because the electrical system is enclosed within partition walls with minimal open heat activities. The severity value in the tenant area was set at level B (Hazardous) due to the potential for serious consequences to life safety and commercial operational continuity, whereas the Check In, Waiting Lounge, and Retail Areas are at level C (Major) because fire consequences in these three areas could disrupt primary terminal services, even though the probability of a fire occurring is relatively lower.

Evaluation of existing conditions shows that Dry Chemical Powder (DCP) fire extinguishers remain effective as initial firefighting media capable of extinguishing Class A, B, and C fires with relatively economical procurement and maintenance costs. However, the fine chemical powder particles tend to form dense dust clouds when used in enclosed, densely populated spaces, thereby reducing evacuation route visibility and triggering mass panic, consistent with interviews with the ARFF Operation Chief and Avsec Terminal Protection. The corrosive DCP residue also has the potential to damage computer circuits in the check-in area and contaminate food in the tenant area, leading to cleaning costs and potential operational downtime post-incident, as confirmed by the ARFF Maintenance Supervisor.

Based on the risk analysis and suitability evaluation results, recommendations for fire extinguisher media zoning were formulated as presented in Table 4.

Table 4 Risk Control Recommendations

Zone	Risk Level	Fire Extinguisher Recommendation	Technical Reasoning
Check In	Moderate (3C)	Clean Agent near electronic devices; DCP retained in other areas	Reduces residue impact on electronic devices and minimizes service operational disruptions
Waiting Lounge	Moderate (3C)	Clean Agent near charging stations and high-density user areas	Reduces visibility disruption, residue, and potential user panic
Tenant (F&B)	High (4B)	Wet Chemical for hot oil fires (Class K); Clean Agent for electrical equipment	Extinguishing media must match kitchen fire characteristics to avoid greater losses
Retail Area	Moderate (2C)	Clean Agent near electrical equipment; DCP retained for non-electronic goods	Adjusted to the type of goods, fire class, asset value, and post-extinguishment residue impact

CONCLUSIONS

The level of fire risk in the departure area of the Yogyakarta International Airport Terminal varies across zones based on hazard identification and likelihood and severity assessments referring to KP Number 242 of 2017. The tenant area has the highest risk level with a High category (4B), while the check-in and waiting lounge areas are in the Moderate category (3C), and the retail area is in the Moderate category (2C). These differences in risk levels indicate that each zone has distinct hazard characteristics requiring tailored risk controls. Evaluation results also show that the dominance of Dry Chemical Powder fire extinguishers in public areas, while effective for initial firefighting, brings secondary residue impacts such as visibility impairment, potential mass panic, and damage to electronic assets and food supplies. Therefore, the phased implementation of Clean Agent fire extinguishers is recommended in the check-in, waiting lounge, and retail areas, alongside Wet Chemical fire extinguishers in the food and beverage tenant area, while Dry Chemical Powder fire extinguishers can be retained at specific points according to the fire class and characteristics of the protected objects. This research is limited to evaluating the suitability of fire extinguisher media types and does not cover cost-benefit analyses or firefighting simulations, so future research is advised to develop these studies and expand the research object to various other types of airports.

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