ANALYSIS OF EQUIPMENT STORAGE AREA MANAGEMENT IN SUPPORTING OPERATIONAL SAFETY AT EL TARI KUPANG AIRPORT

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ABSTRACT

The Equipment Storage Area (ESA) plays a vital role in supporting airside operations, particularly for storing Ground Support Equipment (GSE). At El Tari Airport Kupang, the ESA does not yet meet safety and operational standards, as outlined in PR 21 of 2023 (CASR Part 139). Observations revealed the absence of markings and physical barriers, especially near the drainage channel, posing risks to equipment safety and operational continuity.

This research uses a descriptive qualitative method with data collected through field observations, interviews with Apron Movement Control and ground handling personnel, and documentation. The analysis followed data reduction, presentation, and conclusion drawing to evaluate the ESA's readiness in ensuring airside safety.

Findings show that the lack of visual markings leads to disorganized GSE placement, and the absence of barriers increases the risk of equipment slipping into the drainage. It is recommended to implement clear markings and permanent concrete barriers to enhance safety, order, and compliance with aviation safety standards.

Keywords: *Equipment Storage Area, Ground Support Equipment, Marking, Barrier*

1. INTRODUCTION

In the era of globalization, air transportation plays a vital role in supporting economic growth and regional development due to its advantages in speed, safety, time efficiency, and broad coverage [1]. Airports serve as critical infrastructures that facilitate air transportation, enabling the movement of passengers, cargo, and multimodal connections. According to Indonesian Law No. 1 of 2009, airports function not only as aviation terminals but also as centers of regional economic activity [2].

El Tari Airport in Kupang acts as a major transportation hub in East Nusa Tenggara (NTT), serving numerous daily domestic flights and handling significant volumes of passengers and cargo. Ground Support Equipment (GSE) is essential to airport operations, and at El Tari Airport, over 285 GSE units are utilized, managed by service providers such as PT. Gapura Angkasa, PT. Timor Nusa Dirgantara, and PT. Prathita Titian Nusantara.

However, the Equipment Storage Area (ESA) where these GSE units are housed presents operational safety concerns. Observations revealed irregular GSE arrangement and close proximity between equipment, which could lead to damage and mobility issues. Furthermore, the ESA is directly adjacent to an open drainage channel without physical barriers, posing a risk of equipment slippage.

These issues highlight the need to evaluate the ESA's compliance with national aviation safety standards, particularly those outlined in PR 21 of 2023 by the Directorate General of Civil Aviation. As airside operational safety standards increase globally, improved ESA management is crucial to supporting safe and efficient airport operations. This study aims to provide a data-driven analysis of the ESA at El Tari Airport and propose improvements to ensure safety and regulatory compliance [3].

Moreover, poorly organized storage areas not only increase the likelihood of equipment damage but also delay operational processes such as baggage handling, aircraft servicing, and turnaround times. This can reduce airport efficiency and safety performance, especially during peak flight hours. Inadequate safety measures may also violate international civil aviation requirements and

expose ground operations to preventable risks, making it essential for airport authorities to strengthen facility management through systematic planning and compliance with applicable standards.

Based on the background outlined above, the author formulates the following research question:

1. Does the Equipment Storage Area (ESA) at El Tari Airport Kupang have adequate markings to support the safe and orderly arrangement of Ground Support Equipment?
2. Is the Equipment Storage Area (ESA) at El Tari Airport Kupang equipped with protective barriers between the ESA and the drainage channel to prevent accidents or incidents and support operational safety?

2. METHOD

2.1 Research Design

This research employs a descriptive qualitative approach. Data were collected through documentation, observation, and interviews. This approach provides a comprehensive overview of the actual condition of the Equipment Storage Area management at El Tari Airport Kupang.

2.2 Subject and Object of Reseacrh

Research subjects are individuals, groups, or specific parties who provide information or data regarding the variables being studied [4]. The selection of research subjects should align with the research objectives and the relevance of their involvement in the issues examined. In this study, the subjects are parties directly involved in the operation, supervision, and management of the Equipment Storage Area at El Tari Airport Kupang. First, personnel from Apron Movement Control, who are responsible for regulating and supervising the movement of Ground Support Equipment.[5] Second, ground handling staff, who are the direct users of the Equipment Storage Area.

The research object refers to anything that becomes the focus of attention in a study, whether it is an object, phenomenon, event, person, or concept that is deliberately examined to obtain information and draw scientific conclusions [4]. In this study, the research object is the Equipment Storage Area located at El Tari Airport Kupang.

2.3 Data Collection Techniques

The methods used to collect data were observation, documentation, and interviews.

According to [6], observation is the process of gathering information or data by directly monitoring the phenomenon under study. In this research, direct observation was conducted on the research object to assess the actual condition of the Equipment Storage Area at El Tari Airport Kupang. The aspects observed included the availability and condition of markings.

Documentation is a method of data collection that involves obtaining information from written sources or existing documents [7]. In this study, data were collected through photographs and documents that depict the conditions present in the Equipment Storage Area at El Tari Airport Kupang.

According to [4], Interviews are used as a data collection technique when researchers wish to conduct a preliminary study to identify problems that need to be investigated, as well as when they want to gain more in-depth information from respondents. In this research, interviews were conducted with two informants: one from Apron Movement Control and one from the Ground Handling unit, to gather their perspectives on the phenomena occurring in the Equipment Storage Area at El Tari Airport Kupang.

2.4 Data Analysis Techniques

The data analysis technique used in this research is descriptive qualitative analysis. This technique is applied to describe, interpret, and draw conclusions from data obtained through observation, documentation, and interviews. The analysis does not involve statistical calculations but rather emphasizes understanding the context and meaning of the collected data. According to [8], qualitative data analysis involves three main stages: data reduction, data display, and conclusion drawing/verification. These stages are interrelated and occur continuously throughout the research process.

In the data reduction stage, the researcher simplifies and selects essential data obtained from the field. Data irrelevant to the research focus are eliminated, while information directly related to the condition of the Equipment Storage Area (ESA),

such as the condition of markings and the presence of barriers, is retained for further analysis.

Once the data are reduced, the next step is to present them in a systematic form. Data may be displayed in descriptive narrative form or as photographic documentation. Proper data presentation allows the researcher to identify emerging patterns and facilitates the process of interpretation and decision-making. In this study, data presentation helps explain the actual condition of the Equipment Storage Area in terms of safety, management, and layout effectiveness.

The final stage is drawing conclusions based on the data that have been presented and analyzed. The researcher seeks to uncover the meaning behind the data and identify solutions to the problems found. Verification is carried out by comparing and re-examining data from various sources to ensure the validity and consistency of the information.

This approach is also supported by [7], who states that qualitative analysis aims to construct meaning from collected data through iterative, interpretive, and reflective processes. Therefore, this method is considered the most appropriate for examining complex operational issues such as the management of the Equipment Storage Area in an airport environment.

2.5 Reseacrh Location and Time

The research was conducted at El Tari Airport Kupang, specifically in the Equipment Storage Area located on the airside of the airport. This location was chosen because it reflects the complexity of managing ground support equipment for aviation operations, particularly in terms of arrangement, safety, and the provision of standard facilities such as markings and safety barriers. The study was carried out during the On the Job Training (OJT) period, from January 6, 2025, to July 22, 2025.

3. RESULT AND DISCUSSION

3.1 Result

3.1.1 Placement of Ground Support Equipment in the Equipment Storage Area

Observations conducted in the Equipment Storage Area revealed that the placement of Ground Support Equipment (GSE) is still not well organized. The GSE units are placed in the ESA without any specific pattern, and often block the movement paths of other vehicles. The absence of markings or boundary lines results in a cluttered storage area that is inefficient in supporting smooth apron operations.

Figure 1. Ground Support Equipment are obstructing each other

In interviews with ground handling personnel, they stated that the current placement or storage of equipment is based on the available empty space and the work habits of each shift. As a result, during shift changes, equipment placed by the previous team is often difficult for the next team to locate or access. The lack of visual guidelines makes overlapping equipment placement unavoidable, especially during peak flight hours.

Figure 2. Ground Support Equipment is placed irregularly

Apron Movement Control staff also reported that this situation complicates supervision, as there are no reference lines to arrange or assess whether the GSE has been placed correctly. When placement violations occur, Apron Movement Control can only issue verbal warnings. If such violations are repeated, the matter is reported to the ground handling supervisor or may result in administrative sanctions, such as the suspension of operational permits or airport security passes.

According to Apron Movement Control, if the ESA were equipped with permanent markings, violations could be more easily identified and sanctioned. They compared the necessity of markings in the ESA to zebra

crossings on public roads: people tend to be more orderly when they know where they are supposed to cross or stop. This indicates that clear spatial arrangements and visual guidance greatly influence personnel compliance with field regulations.

3.1.2 Absence of Barriers in the Equipment Storage Area and Lack of Wheel Chock Installation on Ground Support Equipment by Ground Handling

The Equipment Storage Area at El Tari Airport Kupang is located in front of the cargo terminal and adjacent to the Ground Support Equipment maintenance area. Topographically, this area has a higher elevation than the drainage channel, which directly borders it and separates the Equipment Storage Area from the cargo terminal. This slope poses a potential hazard if Ground Support Equipment is not properly secured. Based on observations, it was found that the storage area does not have any permanent physical barriers to prevent equipment from moving or sliding toward the drainage channel. The absence of such safety measures is a serious concern, particularly if wheel chocks are not installed or become dislodged due to operator negligence or external factors such as strong wind gusts.

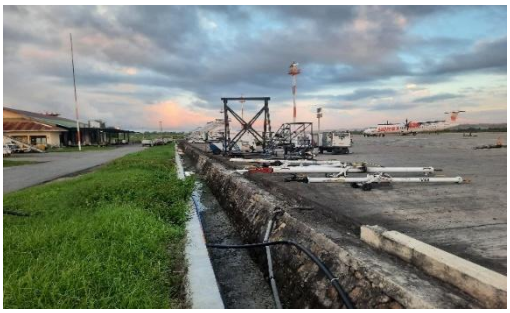

Figure 3. Drainage channel separating the Equipment Storage Area and the cargo terminal

In addition to the lack of supporting infrastructure in the form of permanent physical barriers, it was also found that ground handling personnel do not consistently install wheel chocks on GSE units stored in the area. This indicates the occurrence of human error in the implementation of occupational safety procedures in the field. This is despite the fact that the airport management routinely conducts safety procedure briefings for all ground handling personnel. Furthermore, ramp checks are carried out periodically every three months as a form of direct supervision to ensure compliance with operational standards.

Figure 4. The passenger boarding stairs fell off

3.2 Discussion

3.2.1 Installation of Markings for the Arrangement of Ground Support Equipment in the Equipment Storage Area

Markings were installed in the Equipment Storage Area to improve layout organization and enhance orderliness in the storage and retrieval process of Ground Support Equipment (GSE). The left Equipment Storage Area measures 35 meters in length and 15.4 meters in width, while the right Equipment Storage Area measures 178 meters in length and 15.4 meters in width. Between the left and right storage areas, there is an 8-meter-wide access road leading to the cargo terminal.

The markings were designed in accordance with the Directorate General of Civil Aviation Regulation No. PR 21 of 2023 concerning Technical and Operational Standards for Civil Aviation Safety Regulations Part 139 (Manual of Standard CASR Part 139) Volume I – Land Aerodromes, which stipulates that the words “EQUIPMENT STORAGE” must be painted in red with a letter height of 0.3 meters and positioned 0.15 meters from an unbroken red line 0.1 meters wide. These markings are intended to provide clear visual guidance for ground handling personnel in arranging GSE, while also serving as an official boundary to prevent equipment from encroaching onto stand areas or taxiways.

Both Apron Movement Control and ground handling personnel welcomed the idea of creating these markings. They admitted that, at present, equipment placement is based solely on habit and

intuition. With the presence of markings, they will have a fixed reference that can speed up workflow, prevent overlapping equipment placement, and minimize the risk of operational delays. Additionally, markings can assist new personnel in immediately understanding the designated storage zones from their first day of work.

Beyond improving orderliness and work efficiency, markings are also important for enforcing regulations. Currently, the absence of visual boundaries makes it somewhat difficult for Apron Movement Control to determine whether equipment has been placed correctly. With clear markings, placement violations can be documented, addressed with warnings, and sanctioned if repeated. This will strengthen work discipline and increase compliance with operational safety standards.

3.2.2 Construction and Installation of Permanent Concrete Barriers in the Equipment Storage Area

Observations revealed that the absence of a barrier between the Equipment Storage Area (ESA) and the drainage channel could result in Ground Support Equipment (GSE) stored in the ESA sliding into the drainage channel. This risk is heightened when the equipment is not properly secured, particularly when wheel chocks are not installed, or during adverse weather conditions such as heavy rain and strong winds. To mitigate these potential risks and enhance operational safety on the airside, it is proposed to install concrete road barriers at the rear side of the ESA. These barriers will serve as permanent physical obstacles to prevent GSE from shifting or sliding toward the drainage channel.

Figure 5. Concrete Barrier

The installation of permanent concrete barriers, as illustrated in the figure, provides an effective physical solution to minimize the risk of uncontrolled GSE movement. With the implementation of these barriers, incidents of GSE sliding into the drainage channel—especially when unattended and without wheel chocks—can be prevented. The proposed barrier design features dimensions of 200 cm in length, 80 cm in height, and 60 cm in width. The concrete barriers will be installed closely in a continuous row to form a solid protective line along the side of the ESA that directly borders the drainage channel. With the total length of the ESA's rear side being approximately 213 meters (combined length of both left and right ESAs), around 107 units of concrete barriers, each 2 meters long, will be required. Installation will be adjusted to follow the surface contour of the ESA to ensure maximum protection.

These barriers will also function as the final parking limit, providing ground handling personnel with a clear visual reference for arranging equipment safely and orderly. Concrete was chosen as the material due to its high durability against pressure and extreme weather conditions, which are common in open-air airport environments. Therefore, the implementation of permanent concrete barriers in the ESA should be prioritized as a preventive measure to support operational safety standards.

Figure 3. Permanent Concrete Barrier Installation Area

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

Based on the research findings and discussion presented, the conclusions are as follows:

1. The Equipment Storage Area at El Tari Airport Kupang is not yet equipped with markings in accordance with the Directorate General of Civil Aviation Regulation No. PR 21 of 2023

concerning Technical and Operational Standards for Civil Aviation Safety Regulations Part 139 (Manual of Standard CASR Part 139) Volume I – Land Aerodromes. The absence of such markings results in Ground Support Equipment being placed too closely together, even obstructing access lanes. This condition can increase the likelihood of workplace accidents on the airside and elevate potential safety risks. It indicates that the management of the Equipment Storage Area has not fully implemented operational standards optimally.

2. There is no permanent physical barrier or safety guard in the area. The Equipment Storage Area is directly adjacent to a drainage channel located behind it. This condition poses a serious safety risk to both equipment and personnel, particularly when Ground Support Equipment is not properly secured with wheel chocks. Evidence of this risk includes an incident in which a Passenger Boarding Stair unit slid into the drainage area, illustrating the failure of the physical protection system. Therefore, it can be concluded that the Equipment Storage Area at El Tari Airport Kupang has not fully met operational safety requirements, particularly regarding the structural safety of equipment storage facilities.

4.2 Recommendation

As recommendations based on the findings of this research, the author proposes the following suggestions:

1. El Tari Airport Kupang should implement the installation of markings in the Equipment Storage Area in accordance with the technical provisions set out in the Directorate General of Civil Aviation Regulation No. PR 21 of 2023 concerning Technical and Operational Standards for Civil Aviation Safety Regulations Part 139 (Manual of Standard CASR Part 139) Volume I – Land Aerodromes. The presence of such markings is crucial for creating visual order and assisting ground handling personnel in arranging equipment efficiently and safely, thereby reducing the risk of collisions and obstructions to mobility.

2. El Tari Airport Kupang should promptly install permanent concrete barriers along the boundary of the Equipment Storage Area adjacent to the drainage channel. This installation aims to serve as a physical safeguard to prevent equipment from slipping. Additionally, it is recommended that El Tari Airport Kupang and ground handling companies jointly draft and implement a Letter of Operational Coordination Agreement (LOCA). This document will serve as a formal basis for establishing operational coordination, sharing safety responsibilities in the Equipment Storage Area, and clarifying communication channels between parties. With the LOCA in place, information sharing, issue reporting, and follow-up actions on operational findings can be carried out in a structured, timely, and efficient manner.

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