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Hazard Identification and Risk Analysis in Apron Movement Control Services at Mopah Merauke Airport

Reinyelda Desiane Latuheru [a], *Peter Sahupala* [b*]

[a,b] *Mechanical Engineering, Musamus University Merauke-South Papua Indonesia*

*email: [a] pieter@unmus.ac.id

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ABSTRACT

Airside facilities that directly support aircraft operations include runways, taxiways and aprons. As far as possible, these facilities must be free from all forms of potential dangers and isturbances that could impact aircraft operations. The aim to be achieved is to determine the risk tolerance limit for each potential danger that exists on the Apron Movement Control service side at Mopah Airport by carrying out statistical analysis of each risk that may arise. The analytical method used is descriptive statistical analysis. Respondents were targeted at 50 (fifty) respondents specifically aimed at related parties, including: AMC Personnel, Regulators/Local Aviation Authorities, Mopah Airport Management, Commercial Airlines and Related Services at Mopah Airport which are closely related to the research. The maximum score of respondents' responses to potential danger (Hazard) in the entire Apron Movement Control service activity at Mopah Merauke Airport is 125 with the highest potential in cleaning services and markings/signs on the side of the apron with a risk matrix of 1A, meaning there needs to be risk control/mitigation. which requires management decisions and the potential to be accepted after reviewing the implementation of operations. Mopah Merauke Airport's Apron Movement Control service activities are 125 with the greatest potential in cleaning services and markings/signs on the side of the apron. In this service activity, management decisions are needed in an effort to control the risk/mitigation of the existing potential and this potential can be accepted after reviewing implementation of operations.

1. Introduction [Heading of Section]

The role of air transportation can be seen from the increasing mobility of people, cargo and postal goods both from/into the country and from/out of the country, as well as being able to reach areas that are difficult to reach by other modes of transportation. This increase in demand for air transportation services is accompanied by an increase in the provision of air transportation facilities

and infrastructure as well as demands for personnel competency which continues to be adjusted to developments in the facilities and infrastructure being operated[1].

Airports according to Government Regulation Number 32 of 2021 concerning Aviation Operations are everything related to the operation of airports and other activities in carrying out the functions of safety, security, smoothness and orderliness of aircraft, passenger, cargo and/or postal traffic flows, places intra-and/or inter-modal movement as well as increasing national and regional economic growth[2].

Mopah Airport is one of the airports managed by the Ministry of Transportation through the Directorate General of Civil Aviation. Mopah Airport currently serves Regular Domestic flights from and to Sentani-Jayapura, Makassar, Ewer - Asmat, and Tanah Merah - Boven Digoel, as well as Pioneer Flights from and to Mopah Airport which have Air-Side facilities in the form of Aprons with dimensions (L x W) 269.2 m x 80 m, Runway (runway) with dimensions (L x W) 2,500 m x 45 m, and has 2 (two) Taxiways (connecting runways) with dimensions (L x L) 156.3 m x 25.5 m and 181.5 m x 23 m. Mopah Airport can accommodate Boeing 737-800/900 and Airbus A320 aircraft, with an aircraft parking capacity of 6 parking stands. Currently there are 3 (three) scheduled civil aviation operators operating at Mopah Airport, namely PT. Garuda Indonesia, PT. Lion Air, PT. Wings Air, and PT. Trigana Water. Apart from that, there is 1 (one) non-scheduled civil aviation operator operated by PT. Smart Aviation, and there is also 1 (one) civil aviation operator that serves pioneer flights from/to Mopah Airport, namely PT. Susi Air, as well as 1 (one) civil aviation operator that serves mission flights, namely the MAF Foundation[3].

Airport facilities must be available at every airport to support the implementation of airport activities. Airport facilities consist of basic facilities and supporting facilities[4]. Basic Airport Facilities, consisting of:

1. Aviation security and safety facilities include visual landing aids, facilities and equipment for aviation accident relief and firefighting (PKP-PK) during emergencies, airport electrical power supply systems, and airport perimeter fences.
2. Airside Facilities, consisting of:
    a. Runway, Runway Strip, Runway End Safety Area (RESA);
    b. Taxiway;
    c. Parking Platform (Apron);
    d. Markings and Signs, and
    e. Weather observation facilities and equipment.
3. Landside Facilities, consisting of:
    a. Passenger terminal building;
    b. Cargo terminal building;
    c. Traffic control tower building (Control Tower);
    d. Access road;
    e. Vehicle parking;
    f. Aircraft refueling point;
    g. Administration/office building;
    h. Sanitary facilities;
4. Airport Support Facilities, are facilities that directly or indirectly support airport operational activities that can provide economic value for airports, including:
    a. Aircraft hangar/maintenance workshop building;
    b. Warehousing facilities;
    c. Accommodation/hotel;
    d. Shops, ATMs, restaurants, etc.

Aircraft Parking Platform (Apron) is one of the airside facilities at an airport which is intended to accommodate aircraft activities starting from the pre-flight phase, namely the passenger, baggage/cargo and post handling phase before departure from the airport of origin to the post phase. Flight, namely the passenger, baggage/cargo and postal handling phase upon arrival at the

destination airport. Aircraft service and handling, including vehicles supporting aircraft operational activities on the apron side, are regulated and supervised by Apron Movement Control (AMC) Unit personnel who have met the required competency standards. In general, the duties of Apron Movement Control (AMC) personnel are as follows[5]:

1. Arrange the aircraft parking position;
2. Plan aircraft parking arrangements in abnormal/emergency conditions;
3. Analyze movement on the apron during peak hour/peak season conditions;
4. Supervise the movement of people, vehicles/equipment and aircraft on the side of the apron;
5. Supervise and regulate traffic movement on the apron side;
6. Ensure the cleanliness of the Apron side facilities in good condition;
7. Recording and archiving aircraft movement data on the apron side;
8. Coordinating with related services at the airport for the use of aprons.

Potential Hazard is a condition or condition of people, equipment/machines/aircraft, work installations, work materials, work methods/nature, production processes, and work environments that can cause damage/disruption, loss, accidents, fire/explosion, pollution, and occupational diseases[6].

Figure 1. Mopah Airport Merauke Papua-Indonesia

Specifically Potential Dangers at Airports, People and aircraft face many potential dangers, especially from the movement and operation of aircraft and ground vehicles. Failure to eliminate or control such hazards may result in accidents to aircraft and/or persons or cases of ill health. The following potential dangers that can be encountered on the Apron include[7]:

1. Vehicles that hit aircraft and/or people, due to the uncontrolled speed of operational vehicles, especially on approach to the aircraft and around people;
2. Danger for passengers on the apron, due to personnel failure to supervise passengers walking according to a safe route/lane. Safe routes can also be demonstrated by the use of movable barriers and chains to create temporary safe routes across the apron for passengers to follow, also Routes to the aircraft must not pass under the aircraft's wings or under fuel vents, or close to propellers or rotors the plane they are boarding/desembarking from or from a plane standing nearby.
3. Moving aircraft (including aircraft in pushback and being towed).
4. Aircraft engines that are temporarily running (including helicopters). In particular operating a jet engine or propeller in an unsafe position can cause fatal or serious injuries and serious damage to other equipment or aircraft.
5. Falls or falling objects
6. Operation of aircraft stairs
7. Explosions, Vibrations, Noise and Smoke from Aircraft Engines
8. Dangerous substances and dangerous goods (including radioactive substances)
9. Inadequate lighting, glare or confusing lights

10. Bad weather conditions.

The apron is part of the airside facilities at the airport which functions as an aircraft parking area, a place for boarding and disembarking aircraft passengers, a place for baggage/cargo and aircraft boarding and disembarkation, as well as other activities related to aircraft operations. To support safe and secure flight operations on the apron side, there is an Apron Movement Control (AMC) unit which provides services in regulating and supervising all activities on the air side, especially on the apron side at the airport, starting from controlling the movement of aircraft, controlling the movement vehicles/equipment, monitoring the movement of people, as well as monitoring the cleanliness of the apron[8].

The services provided by Apron Movement Control (AMC) unit personnel play a very important role in supporting the implementation of flight operations so as to create safe and secure flights. The large number of activities on the Apron side requires increased supervision by Apron Movement Control personnel as well. The form of supervision by Apron Movement Control (AMC) unit personnel on the Apron side can start from identifying various potential dangers that will disrupt aviation security and safety. The results of the identification will become material for analysis and assessment of the risk tolerance matrix level to then be taken into consideration in determining mitigation and appropriate control, so that the results of supervision are expected to reduce the potential for accidents and security and safety risks in aviation.

Figure 2. Machine Danger Zone

Aircraft ground service activities on the Apron are activities that take place every day or every flight operation. Apron Movement Control is tasked with supervising and controlling Aircraft Movement Activities on the Apron, supervising and controlling Movement Activities of people, vehicles and equipment (such as: ground support equipment, passenger buses, operational vehicles, Aircraft Passenger Canopy, catering, and fuel vehicles moving on the Apron), Supervising and coordinating airside cleanliness as well as coordinating with related services at the airport for the use of Aprons[1].

With such a large number of activities on the Apron, it is possible for potential dangers and risks to arise in services in the Apron area so that there is a need for hazard identification and risk analysis so that appropriate control/mitigation measures can be found to minimize the potential for accidents[5].

The aim of this research is to determine the risk tolerance matrix for each potential danger that exists on the Apron Movement Control service side at Mopah Airport by conducting statistical analysis of each risk that may arise[9].

2. Method

Hazard Identification is carried out in order to minimize potential dangers to flight safety. Hazard identification is based on a combination of reactive, proactive and predictive safety data collection methods. Hazard identification is the first step in determining the risk value of a hazard. In the process of identifying hazards, there are several things that need to be considered namely[10]:

1. Service providers or flight operators create an effective way to collect, record and provide feedback on hazards by combining reactive methods (a reaction approach to dangers that are occurring), proactive methods (an approach that emphasizes prevention before a danger occurs) and predictive methods (approach by predicting the possibility of potential danger occurring). Collecting or recording safety hazard data must include mandatory reporting, voluntary reporting and confidential reporting.
2. The hazard identification process includes the following steps:
   a. Reporting of safety hazards and events
   b. Collection and storage of hazard and safety event data
   c. Analysis of hazard and safety event data;
   d. Distribution/publication of safety information that has been filtered from safety data.

Safety means a state where the risk of harm to people or damage to property can be reduced and maintained at an acceptable level through a continuous process of hazard identification and risk management[11].

Hazard assessments and risk analysis are carried out to determine the appropriate allocation of resources to hazards and all risks to carry out control and mitigation at an acceptable risk level that threatens aviation safety[12].

In the risk analysis process, the steps taken are to determine the probability of the risk first, then determine the severity/consequences of the risk and then determine the tolerance/tolerance of the risk.

1. Determination of Risk Probability Level.
   Risk probability is the possibility of a potentially dangerous situation occurring. In determining the level of risk probability, it can be determined through several questions, including:
   a. Has a similar event/danger ever occurred before?
   b. Is there equipment or components that may be damaged as a result of this event/hazard?

The probability assessment refers to the Attachment to the Minister of Transportation Regulation Number: 2 of 2020, as in Table 1 below.

Severity level is the worst possible consequence that occurs from a dangerous situation. Determining the level of severity can be determined through the following questions[13].

Table 1. Assessment of Event Probability

Probability of Event		
Definition	Meaning of Definition	Probability Value
Frequency	Maybe it happened many times (has happened many times)	5
Occasional	Maybe it's happened a few times (has happened a few times)	4
Remote	Possible possibility (has happened but is rare)	3
Improbable	Very unlikely to occur (not known to occur)	2
Extremely improbable	Chances are it won't happen	1

Source : data processing, 2024

1. Is there a possibility of loss of life resulting from the incident?
2. Is there a possibility of material/economic or property loss from parties affected by the incident?
3. Is there a possibility of damage to the environment? such as the result of a fuel spill or physical disturbance to natural habitats.
4. Is there any outside media interest or political implications of the incident?

Determining the risk severity value of an incident refers to the Attachment to Regulation of the Minister of Transportation14, as in Table 2 below.

The risk probability and severity values are then integrated into a risk tolerance table which refers to the risk tolerance standard in accordance with the Attachment to the Minister of Transportation Regulation, as in Table 3.

From the results of determining risk tolerance, the risk assessment matrix will be known according to Table 4, If the assessment of a risk is obtained by an unacceptable assessment matrix under existing conditions, efforts must be made to control the risk so as not to cause damage to property/equipment and work health problems, such as fatigue (extreme fatigue due to work), injuries or fatal health risks.

The type of research used in this research is quantitative research. The analytical method used is descriptive statistical analysis, with data presentation in the form of tables and diagrams. The research location was carried out in the Airplane Parking Area (Apron) of Mopah Merauke Airport.

Table 2. Assessment of the Risk Severity of an Event

Keparahan Risiko Suatu Peristiwa		
Definisi Penerbangan	Arti dari Definisi	Nilai Keparahan
Catastrophic	a. Peralatan hancur b. Banyak kematian	A
Hazardous	ı. Penurunan besar dari batas keselamatan, tekanan fisik atau beban kerja yang lebih. ›. Cedera serius atau kematian sejumlah orang :. Kerusakan fatal pada peralatan	B
Major	ı. Penurunan signifikan dari batas keselamatan, dengan berkurangnya kemampuam penyelenggara dalam operasi yang sulit sebagai akibat beban kerja yang meningkat atau sebagai akibat dari kondisi yang mempengaruhi efisiensi penyelenggara ›. Terjadi insiden yang serius :. Terjadi cidera sirius pada orang	C
Minor	ı. Gangguan operasional ›. Keterbatasan operasional :. Penggunaan prosedur penanganan darurat l. Terjadi insiden kecil	D
Negligible	a. Konsekuensi kejadian yang kecil	E

Source : data processing, 2024

Table 3. Risk Tolerance

Probabilitas Risiko	*Risk Severity*				
	Catastrophic A	*Hazarous* B	*Major* C	*Minor* D	*Negligible* E
Frequency 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely Improbable 1	1A	1B	1C	1D	1E

Source : data processing, 2024

Table 4. Risk Assessment Matrix

5A, 5B, 5C, 4A, 4B, 3A	Tidak dapat diterima pada kondisi yang ada
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A, 1B	Pengendalian risiko/mitigasi memerlukan keputusan management. Dapat diterima setelah mengkaji pelaksanaan operasi
3E, 2D, 2E, 1C, 1D, 1E	Dapat diterima

Source : data processing, 2024

This research focuses on identifying hazards and risk analysis on apron services at the Apron Movement Control (AMC) Unit at Mopah Airport in accordance with its duties and authority, which focuses on:

a. Commercial Aircraft Movement Activities operating on the apron side of Mopah Airport.
b. Activities Movement of people, vehicles and equipment moving on the side of the Apron.
c. Cleanliness of the Apron Area which has the potential to cause damage to aircraft on the Apron side.

The questionnaire/questionnaire used in this research is a closed questionnaire/questionnaire, namely the presentation of the questionnaire/questionnaire in such a way that the respondent only needs to tick (√) in the column or place that has been prepared. Respondents were targeted at 50 (fifty) respondents specifically aimed at related parties, including: AMC Personnel, Regulators/Local Aviation Authorities, Mopah Airport Management, Commercial Airlines and related Services at Mopah Airport which are closely related to the research.

Data processing and analysis was carried out to determine the level of significance of each potential danger that exists on the service side of the Mopah Airport Movement Control Apron by conducting statistical analysis of each risk that might arise. From the results of statistical analysis, the risk significance level, probability level and severity of each risk can be determined and then entered

into the Risk Matrix so that appropriate control and mitigation steps can be taken. The flow of data processing and analysis can be described as follows ('Aviation Security', no date):

1. Hazard data obtained from identification results through observation is then followed up by distributing questionnaires. Responses from respondents to the questionnaires submitted will be used as a basis for assessing risk probability and also assessing the severity/consequences of risk for each hazard, which will later be used to determine the level of significance of each identified hazard.
2. Risk Probability Assessment.
   The assessment is carried out by calculating data from research questionnaires/questionnaires using a Likert scale, namely calculating questionnaire results using a scale that measures a person's perception, opinion or response to an event/danger conveyed in the questions in the questionnaire. The assessment aspect of this research is the answer value for each hazard asked, this value will be the reference for assessing the probability of each hazard.
3. Risk Assessment Matrix.
   The results of the risk tolerance assessment are then entered into the risk assessment matrix as in Table 2.4, so that it can be concluded whether the level of significance of the hazard is acceptable or unacceptable.
4. Risk Control and Mitigation.
   a. Risk control is carried out by.
   b. Risk Mitigation, carried out with an approach

3. Results and Discussion

3.1. *Field observation results*

The research was carried out at Mopah Merauke Airport at the apron movement control service unit, with research limitations specifically on services:

Table 5, Potential Hazards in Commercial Aircraft Movement Service Activities on the Apron Side. The results of field observations found several potential dangers (hazards) in aircraft movement services, namely Table 6.

The total number of respondents who were targeted for data collection through questionnaires was 50 respondents, with details of the questionnaire results as shown in Table 7.

Information:

1.1 = Planes can hit/graze buildings/facilities at the airport.
1.2 = The aircraft may hit birds/animals passing by the side of the apron
1.3 = Noise exposure for officers when the aircraft engine is running (Engine Running)
1.4 = The aircraft is not parked according to the available parking stand
1.5 = Airplanes can hit/graze other planes parked in the apron area
2.1 = Passengers walking to or leaving the aircraft are not on a safe route/path
2.2 = The vehicle can hit the aircraft and/or people on the apron, due to the uncontrolled speed of the operating vehicle
2.3 = The aircraft canopy ladder hit part of the aircraft, due to lack of caution by the officer operating the aircraft canopy ladder
2.4 = Officers/Passengers can slip and fall from the aircraft canopy ladder
2.5 = Officers working on the apron side do not use Personal Protective Equipment according to their field of work
1.1 = Marking instructions for the boundaries of the front wheels of the aircraft which are not yet available at the parking stand
1.2 = The surface of the apron on the parking stand is uneven/wavy
1.3 = Spill of aircraft fuel due to lack of caution by refueling personnel
1.4 = Foreign objects dropped/thrown by passengers/officers around the apron which could potentially damage aircraft components

1.5 = Old markings for vehicles or aircraft that are no longer used and have not been erased.
1.6 = Old markings for vehicles or aircraft that are still in use but are no longer visible/clear.

Table 5. Potential Hazards in Commercial Aircraft Movement Service Activities on the Apron Side

No	Potential Hazard	Condition Considered to Be Potentially Hazardous	Worst Risk If Danger Occurs
1	Marking instructions for the boundaries of the front wheels of the aircraft which are not yet available at the parking stand	The aircraft parking position is not uniform because there are no front wheel restrictions in each aircraft parking stand	Airplanes can crash/graze other planes that are parked
2	The surface of the apron on the parking stand is uneven/wavy	The power from the engine is unstable when the plane is about to turn from the parking stand apron to the taxi way	Planes can hit vehicles/equipment and facilities at the airport
3	Airplane fuel spill on Apron	When officers are less careful or overconfident when refueling the aircraft	Operational disruption/limitations/damage to the Apron surface
4	Foreign objects dropped/thrown by passengers/officers on the apron which could potentially damage aircraft components	When the engine is running, foreign objects dropped/thrown by passengers/officers around the apron can be sucked into the aircraft engine.	Causing operational disruption/limitations or damage to aircraft engine components
5	Instructions markings for vehicles/aircraft that are no longer in use and have not been erased	Can confuse the aircraft crew in controlling the aircraft in the apron area	The aircraft departs from a safe path and may endanger aircraft operations
6	Instructions markings for vehicles/aircraft that are still in use but are no longer visible/clear.	Can reduce the concentration of the aircraft crew in controlling the aircraft in the apron area	The aircraft is off course and could endanger aircraft operations

Source : data processing, 2024

The results of field observations found several potential dangers (hazards) in aircraft movement services, namely:

Table 6. Potential Hazards in Commercial Aircraft Movement Service Activities on the Apron Side

No	Potential hazard	Condition Considered to Be Potentially Hazardous	Worst Risk If Danger Occurs

1	Planes can crash/graze buildings/facilities at the airport	The distance between the Parking Stand and the Airport Building, especially the Terminal Building Stairs, is very close when the plane turns from the Apron to Taxi Way or vice versa	Damage to aircraft parts and parts of airport buildings
2	Airplanes can hit birds/animals that cross the side of the apron	There are still flocks of birds flying when airplanes are operating	Damage to aircraft engine components when a rotating aircraft engine hits a bird
3	Noise Exposure to Officers When the Aircraft Engine is Running (Engine Running)	The aircraft engine was running while the Wing Man officer who was handling the aircraft's movement repeatedly did not use PPE in the form of ear plugs	Causing injury/hearing impairment
4	The plane was not parked according to the available parking stand	In crowded conditions, AMC has difficulty determining the safe distance for aircraft that have been parked and those that will be parked on the apron side	Minimize operational disruption/limitations or damage to aircraft parts
5	Planes can crash/graze other planes parked in the Apron Area	AMC officers and wing men are still not paying attention to the distance between the wings of the plane being parked and the plane that will be parked in the parking stand next to it	Causing disruption/operational limitations or damage to aircraft parts

Source : data processing, 2024

3.2. *Questionnaire Count Results*

Based on the distribution of questionnaires carried out to obtain responses regarding probability and severity, these are stated in a matrix. These results can be seen in the questionnaire recapitulation table, table 7.

Table 7. Probability Responses for Questionnaire Respondents

No	Respondent	Response Values for Risk Probability and Severity from Questions														
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**
1	R1	1A	2B	1A	2B	1A	1B	2A	1B	2A	1B	2A	1B	2A	1B	1A	2B
2	R2	3C	3B	5B	5A	5A	4C	2C	3C	2C	3A	3B	2B	2B	3C	2A	2A
3	R3	3D	4C	3C	2C	2C	5D	3B	2B	2B	1B	3C	3C	3C	3C	3C	3C
4	R4	3B	2A	1A	1A	1A	1A	2A	3B	2A	2A	3B	3B	4B	4D	2D	1D

5	R5	3C	4C	2C	1C	2C	4 A	2C	2C	2C	3A	2B	4B	3B	2B	2B	2B
6	R6	1B	2A	1B	1 D	1C	3 A	1B	1B	1B	1B	1A	1A	2B	3B	2A	1A
7	R7	3D	4C	2C	2B	2C	5 D	3D	2D	2D	2D	2D	4D	2D	3D	2D	2D
8	R8	1B	2B	1A	1B	1A	1 A	2A	1B	2A	2B	1A	2B	1A	1B	2A	1A
9	R9	3B	2A	3B	2B	2B	1 A	2B	2B	3C	3A	3B	3A	5B	2C	2B	1B
10	R10	3A	3A	1A	1 A	1A	3 A	1B	1B	3B	3B	1A	3A	3A	3A	1A	1A
11	R11	3B	3A	1B	1 A	1B	3B	1A	1A	1A	3A	1B	4A	4A	1A	4A	3A
12	R12	3B	3A	2B	1 A	2A	3B	1A	1A	1A	3A	5E	5E	3C	5E	2B	2B
13	R13	1A	1A	1A	1 A	1A	1 A	1A	1A	2B	1A	1A	1A	3A	1A	1A	1A
14	R14	1A	1A	1A	1 A	1A	3B	3B	3B	3B	4B	1A	1A	3A	1A	1A	1A
15	R15	4B	5B	3B	3 A	3B	3 A	3B	3B	3C	4A	3B	4D	5D	3B	3B	3B
16	R16	3A	3A	2A	1E	1D	2 A	3C	3B	3D	2A	1A	2A	3B	2A	1A	1A
17	R17	4B	2B	2B	2 A	2B	1 A	2A	1A	2A	2A	2B	2B	3B	2A	1A	1A
18	R18	4C	3C	3C	3 D	3C	4B	3B	3C	3C	3C	3B	3B	4B	3B	3B	3B
19	R19	4C	3C	3C	3 D	3C	4B	3B 3C	3C	3C	3B	3B	3B	4B	3B	3B	3B
20	R20	3B	4B	2B	2E	2C	5B	3B	3C	3C	5B	4A	5A	2B	2B	4B	4C
21	R21	4C	5C	2B	2B	2A	2B	3B	3B	3B	4B	2A	3B	4C	4C	3B	3B
22	R22	3C	3A	1B	1 A	1A	2 A	1A	1A	1A	3B	3A	5B	3B	3B	2A	1B
23	R23	3C	4C	4C	1 A	1A	3B	2C	3D	2C	3B	4D	5D	3C	3C	2D	2D
24	R24	3C	3A	3B	1B	1C	2 A	2B	1B	2B	1A	2B	2B	2B	1A	2B	2B
25	R25	3E	3B	2A	1C	2B	4 A	3C	4C	2B	1A	4A	4A	2B	1A	3A	1A
26	R26	3E	2A	1A	1C	4E	2 A	1B	1D	1A	1E	1A	3B	1B	1B	1A	1A
27	R27	3C	1B	1A	1 A	1A	1 A	1B	2B	2A	1A	1A	1A	2A	1A	2A	2A
28	R28	3C	3C	2B	1C	1C	1 A	1B	2B	2A	1A	2A	2B	2B	3B	1A	1A

29	R29	3B	3B	3B	1C	1C	1A	1B	2B	2A	1A	2C	2C	2B	2C	1A	1B
30	R30	3B	2B	2A	2A	2A	2B	2C	2A	2A	2A	2B	2B	2A	2A	2A	2A
31	R31	2A	3D	2B	1B	1B	3B	2A	3B	2A	1A	1A	2B	2B	2B	1A	1A
32	R32	3D	4C	3B	2C	2C	2C	2C	3C	2B	3C	3A	4C	4C	4B	3A	3A
33	R33	4C	5A	2C	2C	1C	2C	3B	3A	2C	4C	2B	3C	4B	3D	3B	3B
34	R34	3B	4C	2B	1A	2C	5B	3C	3B	2C	5A	4B	5B	3C	2D	4A	4A
35	R35	4C	3B	3B	2C	2B	4A	3B	3A	2B	2A	3A	3A	4B	3C	2B	3A
36	R36	4D	3C	3B	3C	2C	4C	3C	3B	3A	2C	3A	3A	4C	3C	3A	2B
37	R37	3C	4C	2C	2B	2D	5B	3A	2C	2B	2B	2B	4B	2B	3B	2B	2B
38	R38	3B	2C	2C	2C	4C	2A	2B	1B	1C	1B	1B	2C	2B	1C	1A	1A
39	R39	3B	1C	1C	1C	1D	2B	1C	1A	1B	1C	1B	1B	1A	1B	1B	1B
40	R40	3C	3C	2B	1C	2C	5C	2A	3A	3B	2C	5A	4B	4A	2A	3A	2A
41	R41	2C	2C	1B	1C	1B	1A	1B	1C	3C	1A	1B	1A	3C	1A	1B	1B
42	R42	2B	2C	1B	2C	2B	3A	2A	1C	2B	1A	2A	1A	3B	2C	1A	1A
43	R43	1B	2B	1C	2B	1B	1A	2B	1C	2A	2B	1A	2C	1B	1B	2B	2B
44	R44	2B	3B	2A	1B	2C	4B	3C	4B	2A	1C	4B	4B	2B	1C	3A	3B
45	R45	3C	3B	2B	1A	2C	3B	1A	1A	3C	3C	5A	5B	3C	5B	2A	2B
46	R46	3B	3C	1C	1C	1C	3B	1A	1A	3C	3C	1B	4C	4B	1A	4A	4B
47	R47	3C	3C	1C	1B	1C	1C	2B	2A	1B	1B	1A	3A	3C	3D	2B	2B
48	R48	2B	3B	2C	1B	1D	3C	2B	3A	2A	1C	2B	2A	2B	1B	1A	1A
49	R49	3B	2B	2C	2C	2C	3B	2A	2C	2B	2C	2B	2B	2A	2C	2B	2A
50	R50	3C	2B	3C	1C	1C	1A	2C	2B	3A	3B	3B	3A	5B	2C	2A	2B

Source : data processing, 2024

Table 8. Risk Matrix for overall Apron Movement Control Services at Mopah Airport, Merauke

TOLERANCE MATRIX	Question Items on Handling Services Commercial Aircraft Movement on the Apron					Maximum Score	Question Item on Handling the Movement of People, Vehicles/Equipment on the Apron Side					Maximum Score	Question Items on Cleaning Services and Instructions Markings/Signs on the side of the Apron						Maximum Score	Amount Score Maximum
	`1.1	`1.2	`1.3	`1.4	`1.5		`2.1	`2.2	`2.3	`2.4	`2.5		`3.1	`3.2	`3.3	`3.4	`3.5	`3.6		
1A	3	2	8	11	9	33	11	6	8	4	9	38	11	6	2	8	13	14	54	125
1B	3	1	5	6	4	19	1	7	6	3	5	22	5	2	2	6	2	5	22	63
1C	0	1	4	10	8	23	1	1	3	1	3	9	0	0	0	2	0	0	2	34
1D	0	0	0	1	3	4	0	0	1	0	0	1	0	0	0	0	0	1	1	6
1E	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	2
2A	1	4	4	2	3	14	5	8	2	12	5	32	4	2	4	4	8	5	27	73
2B	3	7	9	6	5	30	3	6	6	9	3	27	8	8	12	3	9	10	50	107
2C	1	3	7	7	11	29	2	6	3	5	3	19	1	3	0	5	0	0	9	57
2D	0	0	0	0	1	1	0	0	1	1	1	3	1	0	1	1	3	2	8	12
2E	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
3A	2	6	0	1	0	9	4	1	4	2	5	16	4	6	3	1	5	3	22	47
3B	12	7	7	0	1	27	8	8	8	4	5	33	7	5	5	7	5	6	35	95
3C	12	7	4	1	2	26	1	5	5	8	4	23	1	2	7	5	1	1	17	66
3D	3	1	0	2	0	6	0	1	1	1	0	3	0	0	0	3	0	0	3	12
3E	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
4A	0	0	0	0	0	0	3	0	0	0	1	4	2	2	2	0	3	1	10	14
4B	2	1	0	0	0	3	3	0	1	0	2	6	2	4	6	1	1	1	15	24
4C	5	7	1	0	1	14	2	0	1	0	1	4	0	2	3	1	0	1	7	25
4D	1	0	0	0	0	1	0	0	0	0	0	0	1	2	0	1	0	0	4	5
4E	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5A	0	1	0	1	1	3	0	0	0	0	1	1	2	1	0	0	0	0	3	7
5B	0	1	1	0	0	2	3	0	0	0	1	4	0	3	2	1	0	0	6	12
5C	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	2
5D	0	0	0	0	0	0	2	0	0	0	0	2	0	1	1	0	0	0	2	4
5E	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3	3

Maximum Score for Each Potential	I2	7	9	11	11		11	8	8	12	9		11	8	12	8	13	I4		Maximum Score Risk
Maximum Score for Each Service	12					33	12					38	14						54	125
Number of Respondents	50	50	50	50	50		50	49	50	50	50		50	50	50	50	50	50		

Source : data processing, 2024

3.3. *Discussion*

Data processing from research results is based on the answer value of each question on the questionnaire which is used to determine the risk matrix according to Table 7 for each potential research conducted. The following are the results of processing data on potential hazards in the activities of handling commercial aircraft movements on the apron side. The maximum score of respondents' responses to the potential danger (Hazard) in Commercial Aircraft Movement Handling Activities on the Apron side is 12 on the potential for the aircraft to crash/graze buildings/airport facilities with a risk matrix of 3B and 3C, meaning there needs to be Risk control/mitigation that requires management decisions and the potential to be accepted after reviewing the implementation of operations.

Results of data processing on potential hazards in activities handling the movement of people, vehicles/equipment on the apron side, maximum score for respondents' responses to potential danger (Hazard) in Activities Handling the Movement of people, Vehicles/Equipment on the Apron side is 12, officers/passengers can slip and fall from the plane stairs with a risk matrix of 2A, meaning there needs to be risk control. /mitigation that requires management decisions and Potentially Acceptable after reviewing operational implementation. The maximum score for respondents' responses to potential danger (Hazard) in Cleaning Service Activities and Markings/Signs on the Apron side is 14 for potential indications of old markings for vehicles or aircraft that are still in use but are no longer clearly visible in the risk matrix. is 1A, meaning there needs to be risk control/mitigation which requires management decisions and the potential can be accepted after reviewing the implementation of operations. Results of Risk Matrix Data Processing on the Apron Movement Control service at Mopah Merauke Airport.

From table 8, it can be seen that maximum score of respondents' responses to potential danger (Hazard) in the overall apron movement control service activities at Mopah Merauke Airport is 125 with the highest potential in cleaning services and markings/signs on the side of the apron with a risk matrix of 1A, meaning there needs to be risk control/mitigation. which requires management decisions and the potential to be accepted after reviewing the implementation of operations.Risk control and mitigation is recommended in accordance with the risk tolerance matrix for each potential hazard identified in the Apron Movement control service at Mopah Merauke Airport.

The control in question includes controlling elimination, substitution, technical/engineering, administration and use of PPE, while the mitigation in question includes technology, personnel training and updating regulations/procedures[3].

4. Conclusions

Apron Movement Control services in the activity of handling commercial aircraft movements on the Apron side, the maximum score for respondents' responses was 12 regarding the potential danger of the aircraft crashing/grazing buildings/airport facilities with a risk matrix of 3B and 3C. The potential in matrices 3B and 3C shows that management decisions are needed to control/mitigate risks and also that the potential can be accepted after reviewing the implementation of operations.

In the activity of handling the movement of people, vehicles/equipment on the apron side, the maximum score for respondents' responses was 12 regarding the potential danger that officers/passengers could slip and fall from the plane stairs with a risk matrix of 2A, meaning that for this potential there needs to be a management decision and risk control/mitigation efforts and also the potential to be accepted after reviewing the implementation of the operation.

Overall, the maximum score for respondents' responses to potential danger (Hazard) in the Apron Movement Control service activity at Mopah Merauke Airport is 125 with the highest potential in cleaning services and markings/signs on the side of the apron with a risk matrix of 1A, meaning that in this service activity it is a management decision. necessary in efforts to control risk/mitigation of existing potential and this potential can be accepted after reviewing the implementation of operations.

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