



**KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA**

PRELIMINARY

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Aircraft Accident Investigation Report

PT Indonesia Air Transport

ATR 42-500; PK-THT

Mount Bulusaraung, Maros, South Sulawesi

Republic of Indonesia

17 January 2026

2026

This Written Preliminary Report is published by the *Komite Nasional Keselamatan Transportasi* (KNKT), Transportation Building, 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report is the result of an investigation conducted by the KNKT in accordance with Annex 13 to the Convention on International Civil Aviation, the Indonesian Aviation Act (UU No. 1/2009), and Government Regulation (PP No. 62/2013).

The Written Preliminary Report contains the facts ascertained up to the date of publication and is intended to provide information on the progress of the safety investigation. The information contained in the Written Preliminary Report may be incomplete, may change in the course of the investigation or new relevant facts may become known that have not yet been taken into account. This report does not include analysis and conclusions.

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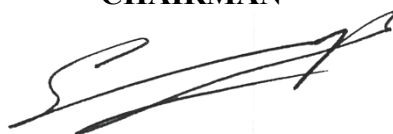
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Jakarta, 20 February 2026

**KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN**



SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

ACC	: Area Control Center
ADS-B	: Automatic Dependent Surveillance – Broadcast
AIP	: Aeronautical Information Publication
AIRAC	: Aeronautical Information Regulation and Control
AMSL	: Above Mean Sea Level
ANP	: Actual Navigation Performance
APS	: Approach Control Surveillance
ATC	: Air Traffic Control
ATCO	: Air Traffic Control Officer
ATPL	: Airline Transport Pilot License
ATR	: Avions de Transport Régional
BASARNAS	: <i>Badan Nasional Pencarian dan Pertolongan</i> (the Indonesian Search and Rescue Agency)
BEA	: <i>Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile</i> (the France Independent Investigation Authority)
C of A	: Certificate Of Airworthiness
C of R	: Certificate Of Registration
CASR	: Civil Aviation Safety Regulations
CPCP	: Corrosion Protection Control Program
CPL	: Commercial Pilot License
CTR	: Control Zone
CVR	: Cockpit Voice Recorder
CWP	: Controller Working Position
DG	: Director General
DGCA	: Directorate General of Civil Aviation
EGPWS	: Enhanced Ground Proximity Warning System
EHSI	: Electronic Horizontal Situation Indicator
FCTM	: Flight Crew Training Manual
FDR	: Flight Data Recorder
GNSS	: Global Navigation Satellite System
GPS	: Global Positioning System
GPWS	: Ground Proximity Warning System
IAT	: Indonesian Air Transport
ICAO	: International Civil Aviation Organization
IFP	: Instrument Flight Procedure
IFR	: Instrument Flight Rules
ILS	: Instrument Landing System

KKP	: <i>Kementerian Kelautan dan Perikanan Republik Indonesia</i> (Indonesia Ministry of Marine Affairs and Fisheries)
KNKT	: <i>Komite Nasional Keselamatan Transportasi</i> (the Indonesia Independent Investigation Authority)
MATSC	: Makassar Air Traffic Service Center
MCDU	: Multifunction Control and Display Unit
MEA	: Minimum Enroute Altitude
MOCA/H	: Minimum Obstacle Clearance Altitude / Height
MSA	: Minimum Sector Altitude
MSAW	: Minimum Safe Altitude Warning
MVA	: Minimum Vectoring Altitude
NM	: Nautical Mile
NPU	: Navigation Processor Unit
NTSB	: National Transportation Safety Board
PBN	: Performance Based Navigation
PF	: Pilot Flying
PIC	: Pilot In Command
PM	: Pilot Monitoring
RNAV	: Area Navigation
RNP	: Required Navigation Performance
SGU	: Symbol Generator Unit
SIC	: Second In Command
SMAC	: Surveillance Minimum Altitude Chart
SOP	: Standard Operating Procedure
STAR	: Standard Arrival
TAWS	: Terrain Awareness and Warning System
TMA	: Terminal Area
TOC	: Top Of Climb
TSB	: Transportation Safety Board
UTC	: Coordinated Universal Time
VHF	: Very High Frequency
VOR/DME	: VHF Omnidirectional Range / Distance Measuring Equipment

SYNOPSIS

On 17 January 2026, an ATR 42-500 aircraft, registration PK-THT, was being operated on an unscheduled flight from Adisutjipto Airport (WAHH), Yogyakarta, Indonesia, with the intended destination of Sultan Hasanuddin International Airport (WAAA), Maros, Indonesia. The aircraft was chartered for an aerial surveillance mission and was planned to conduct an aerial surveillance over four areas.

On board the aircraft were two pilots, two flight attendants, and six passengers (one flight operation officer, two aircraft engineers, and three aerial surveyors).

The Flight Data Recorder (FDR) of the aircraft recorded the Global Navigation Satellite System (GNSS) on degrade mode during most of the flight operation. The aircraft position recorded in the FDR was different from the aircraft position recorded in ground receiver of Automatic Dependent Surveillance–Broadcast (ADS-B). The recorded aircraft coordinate in the FDR was the aircraft position displayed in the EHSI, and the ADS-B data were utilized by the air traffic services (ATS) provider for its surveillance system to display the aircraft target on air traffic controller (ATCO) situation display.

At 0109 UTC, the aircraft departed from Runway 09 of Adisutjipto Airport and climbed to the cruising altitude of 11,000 feet. The flight was then provided with air traffic control services and flight information services.

At 0348 UTC, the PM made initial contact with the ATCO of Ujung Pandang Terminal Control Area (TMA). Thereafter, the PK-THT pilot was instructed to make an approach to Runway 21 using the Instrument Landing System (ILS). Cockpit Voice Recorder (CVR) data indicated that the SIC was the PM and the PIC was the PF.

The ATCO provided air traffic control services utilizing a surveillance system and was accompanied by one planner (assistant controller).

At 0423 UTC, the PK-THT target on the ATCO situation display changed from a surveillance target to a flight plan target meaning that the surveillance system did not receive PK-THT surveillance data. The ATCO repeatedly called the PK-THT pilot. The efforts were unsuccessful in obtaining any responses from the PK-THT pilot.

The search and rescue mission was immediately activated after the Air Traffic Services (ATS) provider notified the Indonesia Search and Rescue Agency (BASARNAS), and on 18 January 2026, the aircraft was found scattered on the Mount Bulusaraung. All persons on board were fatally injured in the occurrence, and the aircraft was destroyed by the impact force.

The investigation involved the participation of the *Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile* (BEA) France as the State of Design and the State of Manufacture, and the National Transportation Safety Board (NTSB) of the United States of America as the State providing assistance. Both agencies have appointed their accredited representatives to assist in this investigation in accordance with the provisions in ICAO Annex 13.

The investigation is ongoing, should any further relevant safety issues emerge during the course of the investigation, KNKT will immediately bring the issues to the attention of the relevant parties and publish them as required.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 17 January 2026, an ATR 42-500 aircraft, registration PK-THT, was being operated by PT Indonesia Air Transport (IAT)¹ Indonesia on an unscheduled flight from Adisutjipto Airport (WAHH), Yogyakarta, Indonesia, with the intended destination of Sultan Hasanuddin International Airport (WAAA), Maros, Indonesia.

The aircraft was chartered by the *Kementerian Kelautan dan Perikanan (KKP) Republik Indonesia* (Indonesia Ministry of Marine Affairs and Fisheries) for an aerial surveillance mission. On board were two pilots, two flight attendants, and six passengers (one flight operation officer, two aircraft engineers, and three aerial surveyors). Based on the filed flight plan, the flight would follow Instrument Flight Rules (IFR) with an intended cruising altitude of 11,000 feet. The route stated in the flight plan indicated that aerial surveillance would be conducted over four areas (see Figure 1).

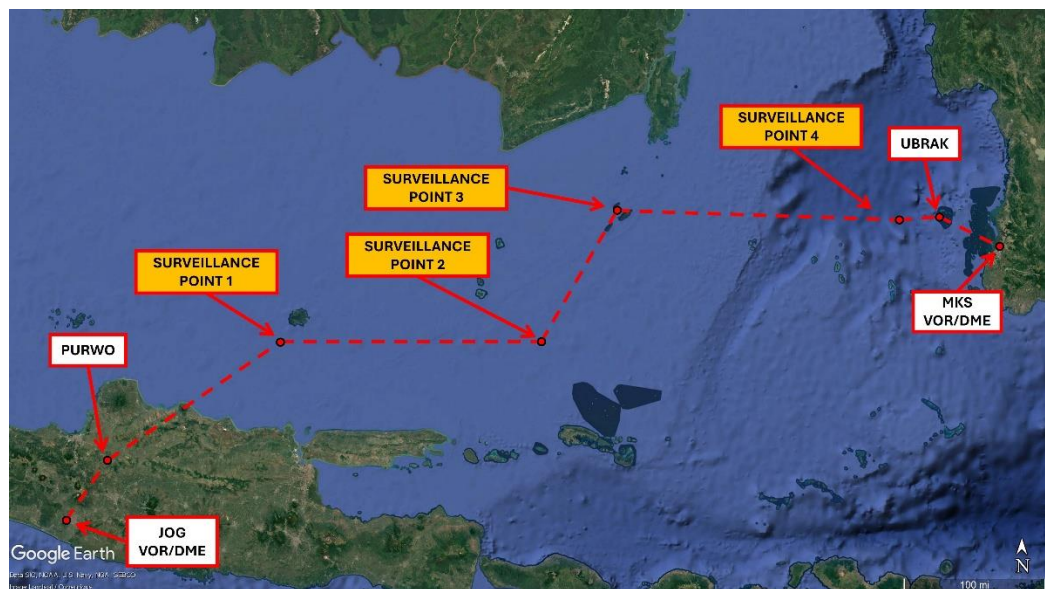


Figure 1: PK-THT route based on flight plan

When the engine had been started, the Flight Data Recorder (FDR) began to record the flight data and the parameter of Global Navigation Satellite System (GNSS) Degrade was recorded as Degrade². At this time, the coordinates recorded on the FDR indicated that the aircraft was at 1 NM southeast of Adisutjipto Airport. At this time, the ground receiver of Automatic Dependent Surveillance–Broadcast (ADS-B)³ had not recorded the broadcasted ADS-B data from the aircraft.

¹ PT Indonesia Air Transport will be named IAT for the purpose of this report.

² GNSS Degraded means that the GPS accuracy or integrity was in problem. In this case the pilot should not navigate the aircraft using the satellite system. See [Subchapter 1.8.1](#).

³ ADS-B is described in [Subchapter 1.8.4](#).

At 0109 UTC⁴, the aircraft departed from Runway 09 of Adisutjipto Airport and climbed to the cruising altitude of 11,000 feet. The flight was then provided with air traffic control services and flight information services.

The investigation could not determine who acted as Pilot Flying (PF) and Pilot Monitoring (PM) during departure.

At 0112 UTC, at an altitude of 5,900 feet, the ADS-B ground receiver started to receive the broadcasted data from the aircraft. At this time, the position of the aircraft was about 0.6 NM northwest of the aircraft position recorded in the FDR, and the distance continued to reduce (the aircraft trajectory from FDR data was getting closer to the trajectory from ADS-B data).

The recorded aircraft coordinate in the FDR was the aircraft position displayed in the Electronic Horizontal Situation Indicator (EHSI) – a display in the cockpit that can be used by the pilot to indicate the aircraft position. The recorded coordinate in the ADS-B ground receiver was the aircraft position displayed in the situation display of the air traffic control surveillance system.

At 0114 UTC, when the aircraft passed an altitude of 7,700 feet, the GNSS Degrade parameter recorded Not Degrade and a few minutes later, the aircraft trajectory from FDR and ADS-B data were superimposed.

At 0117 UTC, the aircraft reached and maintained the cruising altitude of 11,000 feet.

At 0143 UTC, the GNSS Degrade parameter was recorded as Degrade, and it remained so until the end of the FDR recording. About one minute later, the aircraft descended to an altitude of about 2,000 feet to conduct aerial surveillance near Surveillance Point 1.

At 0145 UTC, the aircraft trajectory from FDR data and ADS-B data started to split. The distance between the two trajectories was increasing.

After completing the aerial surveillance, the aircraft climbed to an altitude of 11,000 feet and continued to the next aerial surveillance area.

At 0204 UTC, the aircraft descended to an altitude of about 1,500 feet to conduct aerial surveillance near Surveillance Point 2. After completing the aerial surveillance, the aircraft climbed to altitude of 2,000 feet and continued flying to the next aerial surveillance area.

At 0253 UTC, the ADS-B ground receiver did not receive the broadcasted data from the aircraft.

At 0303 UTC, the aircraft descended to an altitude of about 1,500 feet to conduct the aerial surveillance near Surveillance Point 3. After completing the aerial surveillance, the aircraft climbed to an altitude of 2,000 feet and continued flying to the last aerial surveillance area.

At 0335 UTC, the ADS-B ground receiver started to receive the broadcasted data from the aircraft.

⁴ The 24-hours clock in Universal Time Coordinated (the time based on atomic clocks), is used in this report to describe the Local Time (LT) as specific events occurred. The LT on Adisutjipto Airport is UTC+7 hours, and the LT on Sultan Hasanuddin International Airport is UTC+8 hours.

At 0348 UTC, the PM made initial contact with the Air Traffic Controller (ATCO) of Ujung Pandang Terminal Control Area (TMA). Cockpit Voice Recorder (CVR) data indicated that the SIC was the PM and the PIC was the PF. The ATCO provided air traffic control services utilizing surveillance system and was accompanied by one planner (assistant controller).

The ATCO responded to the PK-THT pilot by establishing surveillance identification⁵ and confirming the aircraft's intended cruising altitude. The PM requested a climb to an altitude of 6,000 feet, thereafter, the ATCO approved the pilot's request and asked for the aircraft's heading. The PM reported to the ATCO that the aircraft would fly to the last aerial surveillance area, which was on crossing radial 283°, about 63 NM from MKS VOR/DME⁶. The ATCO acknowledged the report and instructed the PK-THT pilot to report when the aerial surveillance had been completed. At this time, the FDR data showed the aircraft was about 18 NM west of Surveillance Point 4, while the ADS-B data showed the aircraft was about 22 NM southwest of Surveillance Point 4. The distance between the two aircraft trajectories was about 14 NM.

At 0349 UTC, the PM reported to the ATCO "*We are now heading 090 about 13 miles ahead*" and requested Standard Arrival (STAR)⁷. The ATCO then advised the pilot to expect turning left direct to Waypoint DAKAD⁸, and the advice was read back by the PM.

At 0353 UTC, a supervisor from Ujung Pandang Area Control Center (ACC) came to the ATCO controller working position (CWP), and started a non-duty-related discussion.

At 04:01:29 UTC, the ATCO confirmed the aircraft heading to PK-THT, and the PM responded that the aircraft was on heading 083° to Waypoint DAKAD at altitude of 6,000 feet. At this time, the FDR data showed that the aircraft was about 10 NM west of Waypoint DAKAD, while the ADS-B data showed that the aircraft was about 17 NM southwest of Waypoint DAKAD. The distance between the two aircraft trajectories was about 15 NM.

At 04:01:50 UTC, while maintaining the altitude of 6,000 feet, the cockpit preparations were conducted by the pilots, including completion of the approach checklist, activation of the seat belt sign and landing lights, and verification of the altimeter and cabin altitude settings.

At 04:03:29 UTC, the ATCO reconfirmed the aircraft heading to the PK-THT pilot, and the PM responded that the aircraft was tracking to the Waypoint DAKAD on heading 083° about 0.9 NM from DAKAD. At this time, the FDR data showed the aircraft was about 1 NM west of Waypoint DAKAD, while the ADS-B data showed the aircraft was about 15 NM southeast of Waypoint DAKAD. The distance between the two aircraft trajectories was about 15 NM.

⁵ Surveillance identification is the situation which exists when the position indication of a particular aircraft is seen on a situation display and positively identified.

⁶ MKS is a Makassar Very High Frequency (VHF) Omni Range transmitter with the frequency of 110.0 MHz, which is located at a coordinate of 05°03'08.6" S 119°34'01.3" E.

⁷ STAR is a designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

⁸ Waypoint DAKAD is one of Waypoint in the STAR of Runway 21, the waypoint is located about 35 Nm, and 317° outbound MKS VOR, at coordinates of 04°40'39.00" S 119°13'4.00" E.

At 04:03:42 UTC, the ATCO intended to advise the PK-THT pilot that the aircraft was far from Waypoint DAKAD using the phrase “*DAKAD your not, not point*” and instructed the aircraft to turn left to heading 360° for sequencing. The PM read back only the turning instruction.

At 0405 UTC, the PM requested a heading change to 020° from the ATCO to avoid weather conditions, and it was approved by the ATCO.

At 04:10:00 UTC, the PM reported to the ATCO that the aircraft was ready to turn to the right. The ATCO instructed the PK-THT pilot to turn to the right, direct to Waypoint ARAJA⁹, maintain 6,000 feet, and cleared the aircraft to make an approach using the Instrument Approach Landing System (ILS). The PM then requested a left turn instead due to weather conditions.

At 04:10:22 UTC, the ATCO advised the PK-THT pilot that turning left was not possible and instructed the pilot to descend to 5,000 feet as there was another arrival traffic maintaining an altitude of 6,000 feet. The PM read back the descending instruction and traffic information. As the PK-THT target seen turning to the left on ATCO situation display, the ATCO readvised the PK-THT pilot that turning left was not possible. The PM then responded that they would turn to the right on heading 020°. Thereafter, the assistant controller went to rest room.

At 0411 UTC, the ATCO instructed the PK-THT pilot to turn to the left direct to Waypoint ARAJA and issued approach clearance to Runway 21 using the ILS. The PM acknowledged the ATCO instruction. Several seconds later, the ATCO situation display showed that PK-THT target reached and maintained an altitude of 5,000 feet.

The ATCO noticed on his situation display that the PK-THT target did not track to Waypoint ARAJA, and at 0416 UTC, the ATCO instructed the PK-THT pilot using the phrase “*vector to OPENG¹⁰ turn left heading 125°*” and the PM responded, “*turn left heading 125°*”. Thereafter, the ATCO communicated with several other pilots providing air traffic control services. When there was no communication with the other pilots, the non-duty-related discussion between the ATCO and ACC supervisor continued, while the PK-THT passed abeam Waypoint OPENG.

At 04:20:04 UTC, the ATCO situation display indicated that the PK-THT target at an altitude of 5,000 feet, entered an area with a minimum safe altitude of 8,000 feet¹¹, and the Minimum Safe Altitude Warning (MSAW)¹² from the surveillance system did not activate.

At 04:20:46 UTC, the PM confirmed to the ATCO whether the aircraft was still maintaining heading 125° and an altitude of 5,000 feet. The ATCO then instructed the PK-THT pilot to turn to the right, direct to Waypoint KABIB¹³. The PM acknowledged the instruction and confirmed whether the aircraft was maintaining 5,000 feet, to which

⁹ Waypoint ARAJA is an Initial Approach Fix (IAF) for ILS approach procedure to Runway 21 which located about 21 NM on Radial 011° MAK VOR/DME (see [Subchapter 1.8.2](#)).

¹⁰ Waypoint OPENG is located 17 NM on Radial 011° MAK VOR/DME.

¹¹ This defined minimum safe altitude is based on Air Traffic Control Surveillance Minimum Altitude Chart (SMAC), see [Subchapter 1.8.3](#).

¹² Minimum Safe Altitude Warning (MSAW) is described in [Subchapter 1.17.2](#).

¹³ Waypoint KABIB is an Intermediate Fix (IF) for ILS approach procedure to Runway 21 which located 10.5 NM on Radial 011° MAK VOR/DME.

the ATCO instructed the PK-THT pilot to descend to an altitude of 3,200 feet and direct to the Waypoint KABIB for intercepting the ILS.

At 04:22:24 UTC, the ATCO situation display indicated that the PK-THT target did not head to Waypoint KABIB, and the ATCO instructed PK-THT pilot to turn to the right, proceeding to final. The PM responded that the aircraft was headed to Waypoint KABIB. At this time, the FDR data showed the aircraft was about 16 NM northeast of Waypoint KABIB, while the ADS-B data showed the aircraft was about 6 NM east of Waypoint KABIB.

At 04:22:36 UTC, the ATCO advised the PK-THT pilot that the Waypoint KABIB had passed and confirmed whether the pilot was turning the aircraft to the right on heading 245°, proceeding to final Runway 21. A few seconds later, the ATCO situation display indicated that the PK-THT target at an altitude of 4,100 feet descending, entered an area with a minimum safe altitude of 6,000 feet, and the MSAW did not activate.

At 04:22:45 UTC, the PM responded to the ATCO that the aircraft was turning right on heading 245°. Shortly thereafter, the aircraft's Enhanced Ground Proximity Warning System (EGPWS) generated aural alerts "TERRAIN - TERRAIN" followed by "PULL UP" four times. The CVR stopped recording soon after the EGPWS warnings.

At 0423 UTC, the PK-THT target on the ATCO situation display changed from a surveillance target to a flight plan target. This condition indicated that the surveillance system did not receive PK-THT surveillance data. A few moments later, the assistant controller returned to the CWP.

The ATCO repeatedly called the PK-THT pilot. The efforts were unsuccessful in obtaining any responses from the PK-THT pilot.

1.2 Injuries to Persons

All persons on board were Indonesian and were fatally injured in the occurrence.

1.3 Damage to Aircraft

The aircraft was destroyed by the impact force.

1.4 Other Damage

There was no other damage to property and/or the environment.

1.5 Personnel Information

1.5.1 Pilot Information

1.5.1.1 Pilot In Command

Gender	: Male
Age	: 58
Nationality	: Indonesia

Date of joining company : 16 January 1989
 License : ATPL
 Date of issue : 21 April 1994
 Aircraft type rating : ATR 42/72
 Instrument rating validity : 30 April 2026
 Medical certificate : Class 1
 Last of medical : 28 July 2025
 Validity : 31 January 2026
 Medical limitation : Holder shall possess glasses that correct for near vision

 Last line check : 31 October 2025
 Last proficiency check : 14 October 2025
 ICAO language proficiency : Level 4
 Date of test : 16 October 2025
 Validity : 16 October 2028

Flying experience

Total hours : 14,956 hours 16 minutes
 Total on type : 3,358 hours 45 minutes
 Last 90 days : 107 hours 42 minutes
 Last 30 days : 55 hours 42 minutes
 Last 7 days : 1 hour 45 minute
 Last 24 hours : 1 hour 45 minute
 This flight : 3 hours 30 minutes

1.5.1.2 Second In Command

Gender : Male
 Age : 25
 Nationality : Indonesia
 Date of joining company : 16 January 1989
 License : CPL
 Date of issue : 19 September 2020
 Aircraft type rating : ATR 42/72
 Instrument rating validity : 31 December 2026
 Medical certificate : Class 1

Last of medical : 4 November 2025
Validity : 6 May 2026
Medical limitation : None
Last line check : 1 May 2025
Last proficiency check : 9 December 2025
ICAO language proficiency : Level 4
Date of issue : 1 July 2025
Validity : 1 July 2028

Flying experience

Total hours : 524 hours 13 minutes
Total on type : 346 hours 13 minutes
Last 90 days : 49 hours 28 minutes
Last 30 days : 10 hours 52 minutes
Last 7 days : 3 hours 15 minutes
Last 24 hours : 1 hours 45 minutes
This flight : 3 hours 30 minutes

1.5.2 Air Traffic Controller Information

1.5.2.1 Controller On Duty

Gender : Male
Age : 41 years old
Nationality : Indonesia
Date of joining company : 2013
License : Air Traffic Control License
Date of issue : 1 July 2015
Type rating : Approach Control Surveillance (APS)
Date of issue : 1 September 2025
Validity : 8 February 2026
Medical Certificate : Class 3
Last of medical : 26 February 2024
Validity : 26 February 2026
Medical limitation : NIL
ICAO language proficiency : Level 4
Date of issue : 8 July 2025

Validity : 8 July 2028

Working experience : 18 years

Working time¹⁴

Last 7 days : 12 hours

Last 24 hours : 6 hours

Duty time¹⁵

Last 7 days : 2 hours

Last 24 hours : 1 hour

1.5.2.2 Planner (Assistant Controller)

Gender : Male

Age : 29 years old

Nationality : Indonesia

Date of joining company : 2017

License : Air Traffic Control License

Date of issue : 8 September 2017

Type rating : Approach Control Surveillance (APS)

Date of issue : 1 September 2025

Validity : 28 February 2026

Medical Certificate : Class 3

Last of medical : 26 February 2024

Validity : 26 February 2026

Medical limitation : NIL

ICAO language proficiency : Level 4

Date of issue : 10 March 2023

Validity : 10 March 2026

Working experience : 8 years

Working time

Last 7 days : 24 hours

Last 24 hours : 6 hours

Duty time

Last 7 days : 4 hours

14 The working time is the time period when the person attends their particular working shift.

15 The duty time is the time period when the person performs their duty to provide air traffic control service.

Last 24 hours : 0

1.6 Aircraft Information

1.6.1 General

Registration Mark : PK-THT
Manufacturer : Avions De Transport Regional
Country of Manufacturer : France
Type/Model : ATR 42-500
Serial Number : 611
Year of Manufacture : 2000

Certificate of Airworthiness

Date of issue : 5 October 2025
Validity : 4 October 2026
Category : Transport
Limitation : None

Certificate of Registration

Number : 2756
Date of issue : 20 July 2023
Validity : 19 July 2026
Time Since New : 24,965 hours 30 minutes
Cycles Since New : 24,464 cycles
Last Major Check : Corrosion Protection Control Program (CPCP) 2 Years and CPCP 4 Years on 22 October 2024 (24,426 hours 34 minutes and 24,069 cycles)
Last Minor Check : Calendar Inspection 2 Months on 15 January 2026 (24,960 hours 20 minutes and 24,461 cycles)

1.6.2 Engines

Manufacturer : Pratt and Whitney
Type/Model : PW127E
Serial Number-1 engine : PCE-AM0114
Time Since New : 25,552 hours 28 minutes
Cycle Since New : 24,155 cycles
Serial Number-2 engine : PCE-EB0039

Time Since New : 23,646 hours 20 minutes
Cycle Since New : 23,150 cycles

Based on the load sheet, the aircraft was operated within the weight and balance envelope.

1.6.3 Terrain Awareness Warning System

Terrain Awareness Warning System (TAWS) installed in the aircraft is the EGPWS MK8, with part number 965-1206-011.

IAT version Flight Crew Operating Manual (FCOM) Chapter Description (DSC): Navigation - GPWS describes that the EGPWS provides visual and aural alerts in case of dangerous flight path conditions, which would result in inadvertent ground contact.

The EGPWS performs several alert modes, including Enhanced Modes: Terrain and Obstacle Awareness, and Basic EGPWS Modes: Mode 2 - Excessive Terrain Closure Rate.

The Enhance Modes of Terrain and Obstacle Awareness of the EGPWS uses aircraft geographic position provided by an aircraft GPS or an optional internal GPS card, aircraft altitude and worldwide terrain database to predict potential conflicts between the aircraft flight path and the terrain, and to provide aural alert and graphic displays of the conflicting terrain. When the aircraft penetrates the caution envelope boundary, the system generates an aural message TERRAIN AHEAD - TERRAIN AHEAD or OBSTACLE AHEAD - OBSTACLE AHEAD (for obstacle detection) and the red GPWS warning lights illuminate on each instrument panel. Simultaneously, terrain areas, which conflict with the caution criteria, are shown in solid yellow on the terrain display.

If the aircraft penetrates the warning envelope boundary, an aural message TERRAIN AHEAD - PULL UP or OBSTACLE AHEAD - PULL UP (for obstacle detection) is generated with the red GPWS lights illuminate on each instrument panel. Simultaneously, terrain areas, which conflict with the caution criteria, are shown in solid red on the terrain display.

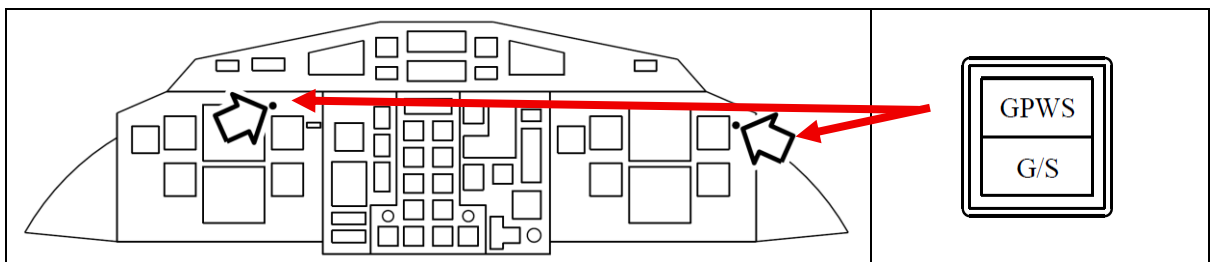


Figure 2: The GPWS lights in the cockpit

The Basic EGPWS Mode 2 calculates an excessive terrain closure rate using the radio altimeter. When the aircraft penetrates the envelope, the system generates TERRAIN - TERRAIN voice alert and the red GPWS warning lights illuminate on each instrument panel. If the aircraft continues to penetrate the envelope, the PULL UP voice alert will be generated with the red GPWS lights always remaining illuminated.

1.7 Meteorological Information

The meteorological reports for Sultan Hasanuddin International Airport, issued on 17 January 2026 were as follows:

Time (UTC)	0330	0400	0430
Wind	240° / 3 knots with variable direction between 210° and 290°	250° / 8 knots	250° / 13 knots
Visibility	9 km	9 km	9 km
Weather	Showers in the vicinity	Showers in the vicinity	Showers in the vicinity
Cloud	Few ¹⁶ Cumulonimbus 1,700 feet	Few Cumulonimbus 1,700 feet; Scattered ¹⁷ 1,800 feet	Few Cumulonimbus 1,700 feet
Temperature / Dew Point	30°C / 27°C	30°C / 27°C	31°C / 27°C
QNH ¹⁸	1,008 mb	1,008 mb	1,007 mb
Remarks	Cumulonimbus in approach area	Cumulonimbus in approach area	Cumulonimbus in approach area

The weather radar and satellite imagery at 0420 UTC indicated the presence of convective cumulonimbus clouds around the accident site (annotated inside a black circle in Figure 3).

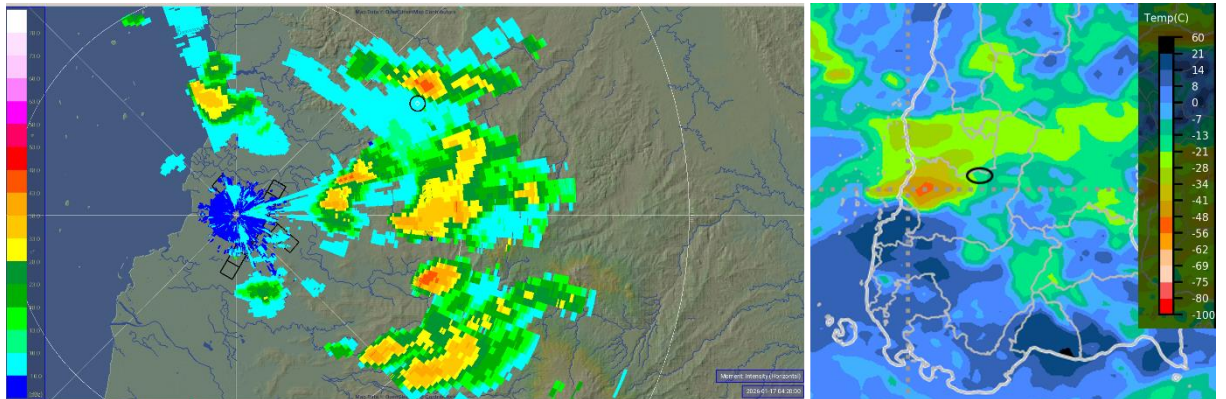


Figure 3: Weather radar image (left) and satellite image (right) at 0420 UTC

16 Few is 1 up to 2 oktas of cloud coverage, meaning only a few clouds are present in the sky.

17 Scattered is 3–4 oktas of cloud coverage, indicates a moderate presence of clouds, more than “Few” but not enough to dominate the sky.

18 QNH is the pressure set on the subscale of the altimeter so that the instrument indicates its height above sea level. The altimeter will read runway elevation when the aircraft is on the runway.

1.8 Aids to Navigation

1.8.1 Aircraft On-board Navigation System

The ATR 42-500 Navigation System utilizes the GNSS, which receives and processes the Global Positioning System (GPS) signals from orbiting satellites. The GNSS installed in the PK-THT aircraft is the HT1000 Global Navigation Management System (HT1000 System) manufactured by Honeywell.

The HT1000 system comprises Navigation Processor Unit (NPU), Multifunction Display Control Unit (MCDU), and a GPS antenna installed on top of the aircraft fuselage. By tracking up to 12 satellites at a time using the information provided by a constellation of 24 satellites orbiting the Earth, the HT1000 system provides the three-dimensional (latitude, longitude, altitude) location and navigation capability to the aircraft. A typical HT1000 system is shown in Figure 4.

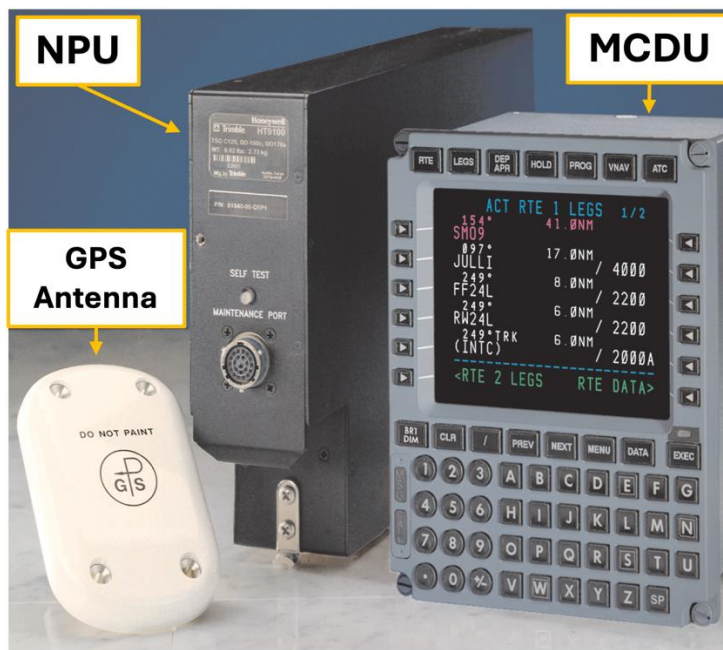


Figure 4: The typical GNSS HT1000 system (taken from HT1000 GNSS Navigation Management System Pilot's Guide, annotated by KNKT)

The NPU (a black colored box in Figure 4) showed that the NPU model was HT9100, the NPU of HT1000 system has a similar box.

Using an updated navigation database, the GNSS provides enroute and terminal area guidance, autopilot coupling, roll steering, and vertical deviation (non-coupled), along a defined flight plan, selected on the MCDU.

The navigation database is stored in the NPU and is updated every 28 days on the ground using a specific data loader. The effective date periods are displayed on the MCDU IDENT page. At the time of the occurrence, as reported in the Aircraft Technical Log on 13 December 2025, the aircraft had been uploaded with a navigation database with the Aeronautical Information Regulation and Control (AIRAC) cycle of 2513, which was effective from 25 December 2025 to 22 January 2026.

The NPU also provides the GPS positioning (latitude, longitude, and altitude) function, which is supplied to the Symbol Generator Unit (SGU). The SGU then supplies the information to the Electronic Horizontal Situation Indicator (EHSI) to provide the pilot with the location of the aircraft relative to the nearest waypoint and provides an annunciation of the GPS quality status (such as GNSS degradation) on the EHSI and MCDU. The aircraft interface to the HT1000 system schematic is shown in Figure 5.

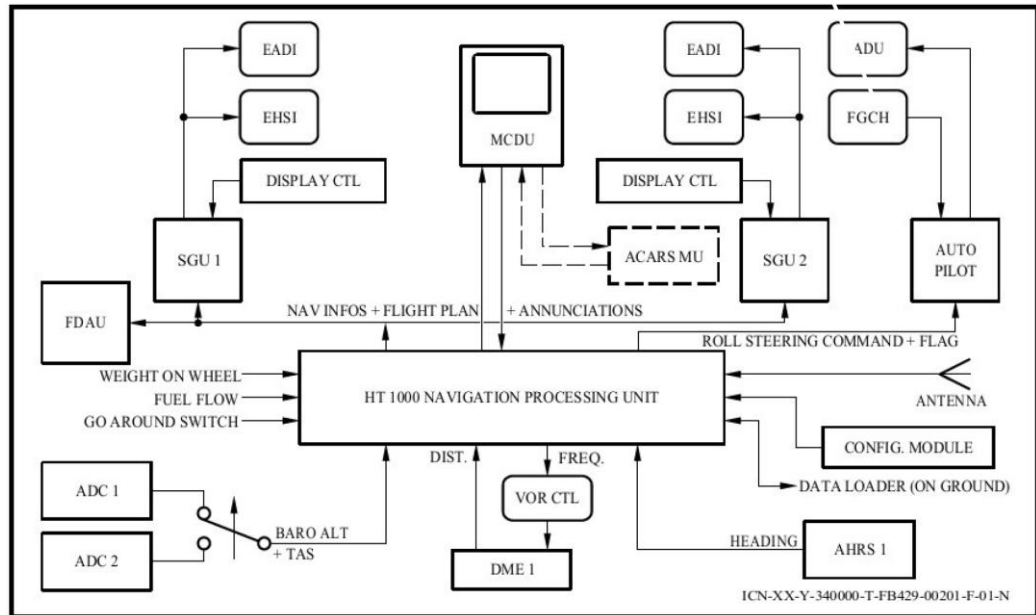


Figure 5: The aircraft interfaces to the GNSS HT1000 schematic system

With the HT1000 System, the aircraft had the capability to conduct Performance Based Navigation (PBN). The FCOM Chapter Limitation (LIM), Subchapter 34.3, states that the PBN capability of the aircraft is RNAV 5¹⁹.

When the HT1000 system enters a degraded mode, the amber DGR alarm display will be displayed in the EHSI as shown in Figure 6.

¹⁹ According to the ICAO Doc 9613 Performance Based Navigation, RNAV means a navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g., RNAV 5, RNAV 1. The RNAV 5 means that it provides the operator with criteria to enable operation in airspace where the carriage of RNAV meeting 5 NM lateral accuracy.

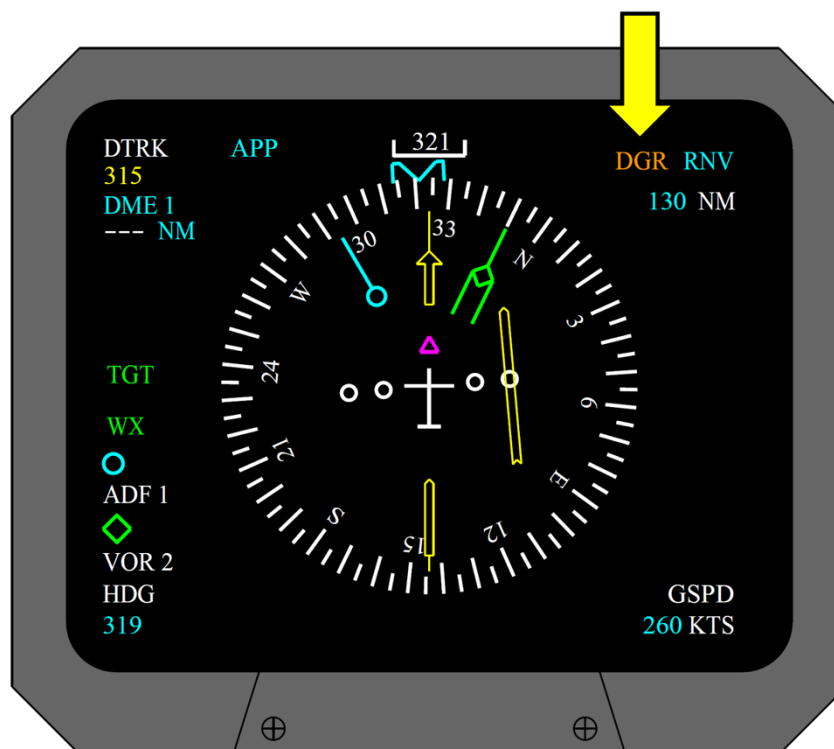


Figure 6: Typical DGR alert message in the EHSI (annotated in yellow arrow by KNKT)

FCOM Chapter Description (DSC). Subchapter 2.5: EHSI - Full Mode, describes that DGR illuminates in amber on the EHSI when the “UNABLE RNP” message is displayed in the MCDU. The “UNABLE RNP” message displayed in the MCDU can trigger an External System Warning “RNV MSG (1)” in the Electronic Attitude Director Indicator (EADI).

FCOM Chapter DSC, Subchapter 2.6: EADI, describes that “UNABLE RNP” message will be annunciated when Actual Navigation Performance (ANP) does not meet the Required Navigation Performance (RNP) or when the integrity is greater than twice the selected RNP. The condition for displaying this message is flight phase dependent as follows:

Phase of Flight	Default RNP (Nm)	Unable RNP Time to Alarm (seconds)
OCEANIC	12	80
EN ROUTE	2	80
TERMINAL	1	60
APPROACH	0.3	10

1.8.2 Instrument Landing System

Runway 21 of Sultan Hasanuddin International Airport is equipped with an Instrument Landing System (ILS) that provides lateral (localizer) and vertical (glideslope) position information using angular deviation signals from the localizer antennas and

the glideslope antennas. At the time of the occurrence, the ILS was reported to be functioning normally.

Aeronautical Information Publication (AIP) Volume II Subchapter WAAA AD 2.24-11G contained the Instrument Approach Chart for ILS Runway 21 as shown in the Figure 7.

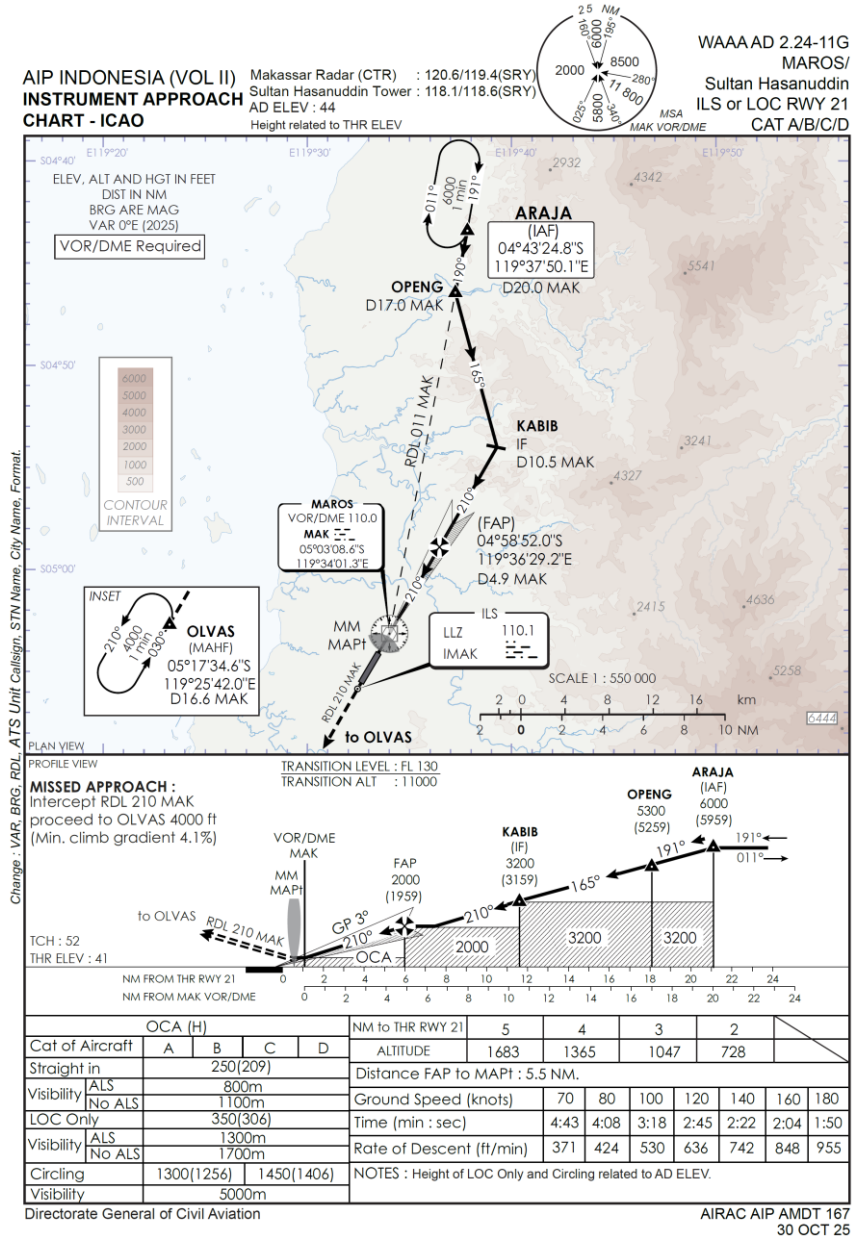


Figure 7: Approach Chart of ILS Runway 21

1.8.3 ATC Surveillance Minimum Altitude Chart (SMAC)

AIP Volume II Subchapter WAAA AD 2.24-10 contained the Air Traffic control Surveillance Minimum Altitude Chart (SMAC) that provides information of minimum altitude on certain areas as reference for the ATCO when providing altitude clearance. The minimum altitude will ensure required terrain/obstacle clearance and help pilots

to cross-check assigned altitudes during terminal operations. The accident site (Mount Bulusaraung) was within an ATC SMAC of 6,000 feet.

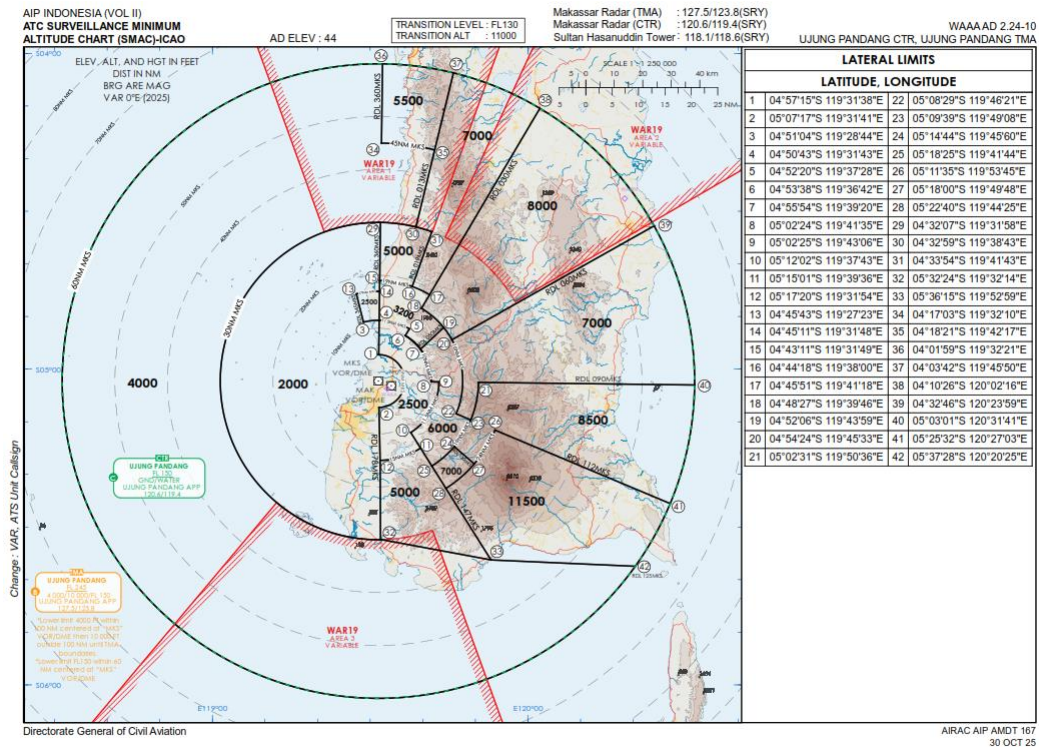


Figure 8: ATC SMAC within the Ujung Pandang Control Zone (CTR) and Terminal Area (TMA)

1.8.4 Automatic Dependent Surveillance – Broadcast (ADS-B)

ADS-B is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

The “automatic” in the ADS-B means that the technology does not require flight crew or external input. The “dependent” means its surveillance process depends on data from on-board aircraft systems to provide surveillance information to the receiver and “broadcast” means the originating source has no knowledge of who receives the data and there is no interrogation or two-way communication.

Ground receivers were installed in several places in Indonesia including in the location that received ADS-B data of PK-THT during the accident flight. The received ADS-B data were utilized by the air traffic services (ATS) provider for their surveillance system to display the aircraft target on the ATCO situation display.

1.9 Communications

All communications between ATCO and the pilot were recorded by ground-based automatic voice recording equipment and the Cockpit Voice Recorder in the aircraft. The quality of the aircraft’s recorded transmissions was good.

The aircraft was equipped with two Very High Frequency (VHF) radio communication systems. The pilot used two of the VHF radios for routine communications with ATCO. All VHF radios were serviceable.

1.10 Aerodrome Information

Sultan Hasanuddin International Airport (WAAA) is operated by Injourney Airport that has a valid airport certificate. The relevant information about the airport is as follows:

Coordinate	:	05°03'39" S 119°33'16" E
Elevation	:	44 feet
Runway Direction	:	03/21 and 13/31
Runway Length	:	3,500 meters for 03/21 and 2,620 meters for 13/31
Runway Width	:	60 meters (All runways)
Surface	:	Asphalt (All runways)

1.11 Flight Recorders

The aircraft was fitted with a Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR). Both recorders were recovered from the accident site on 21 January 2026 by the search and rescue team. The recorders were transported to the KNKT recorder facility for data readout.

On 23 January 2026, the data download and read-out were performed in the KNKT Recorder Laboratory by KNKT investigators with the participation of flight recorder specialists from the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA France) as Accredited Representatives.

1.11.1 Flight Data Recorder

The aircraft was fitted with a FA2100 FDR manufactured by L3 Technologies with part number 2100-4043-00 and serial number 000182186. The FDR recorded more than 170 hours of flights, including the accident flight, and more than 180 parameters, including the parameter of GNSS Degrade that provides the status of the aircraft GNSS, and the parameter of latitude and longitude that provide the aircraft position information.

The accident flight record indicated that since the FDR began recording data (when one of the engines had been started), the parameter of GNSS Degrade indicated that the aircraft GNSS was in Degrade mode (DGR). When the aircraft climbed, passing an altitude of 7,700 feet, the GNSS Degrade parameter recorded Not Degrade. The GNSS Degrade parameter recorded DGR again about one minute before the aircraft descended from the cruising altitude of 11,000 feet, and the DGR remained until the end of the FDR recording.

The accident flight record also indicated that since the FDR began recording data, the coordinates recorded on the FDR indicated that the aircraft was 1 NM southeast of Adisutjipto Airport. When the ADS-B ground receiver started to receive the broadcasted data from the aircraft, as the aircraft climbed passing altitude of 5,900 feet, the position of the aircraft was about 0.6 NM northwest of the aircraft position recorded in the FDR, and the distance continued to reduce (aircraft trajectory from FDR data was getting closer to the trajectory from ADS-B data). When the aircraft

climbed, passing an altitude of 7,700 feet, the aircraft trajectories from FDR and ADS-B data were superimposed. The aircraft trajectory from FDR data and ADS-B data started to split again when the aircraft was descending to an altitude of about 2,000 feet. The distance between two trajectories increased gradually up to 17 NM until the end of FDR recording.

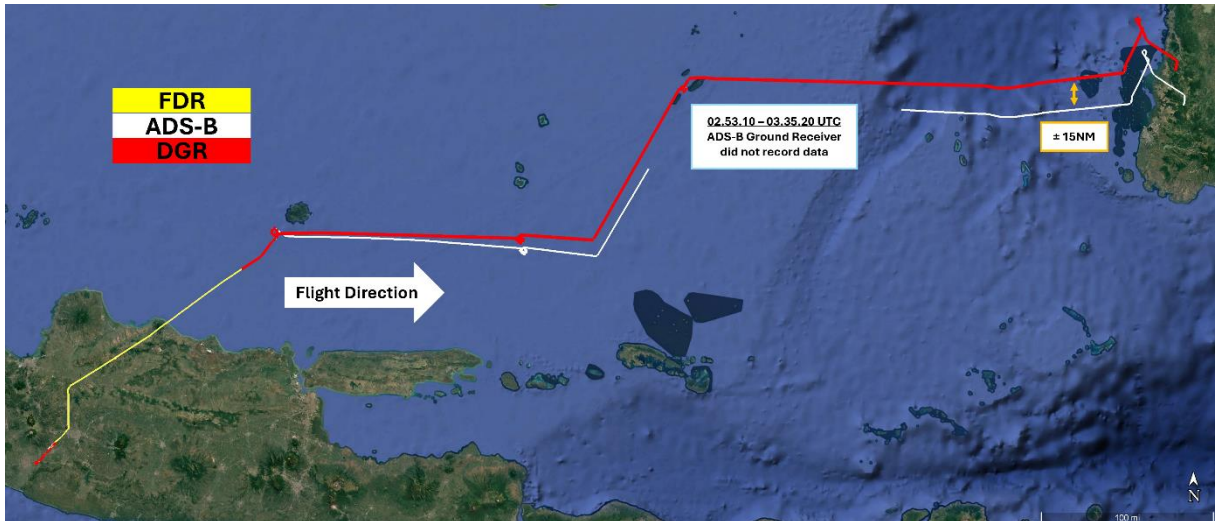


Figure 9: Aircraft trajectories based on FDR (yellow line) and ADS-B (white line) with Degraded mode (red line)

1.11.2 Cockpit Voice Recorder

The aircraft was fitted with an FA2100 FDR manufactured by L3 Technologies, with part number 2100-1020-00 and serial number 638.

The CVR contained 2 hours and 3 minutes of standard quality audio recordings in 2 channels and 30 minutes of high-quality audio recordings in 4 channels. The unintelligible pilot discussion recorded on the Cockpit Area Microphone channel indicated that both pilots did not use headsets and boom microphones during the accident flight.

1.12 Wreckage and Impact Information

The initial impact location (see Figure 10) was at the coordinates of 4°55'44.37" S; 119°44'50.008" E at an elevation of about 4,300 feet above mean sea level (AMSL). The wreckage was scattered about 700 × 200 meters on the slope of about 80° (see Figure 11).



Figure 10: Initial impact mark (inside the red square) with illustration of the flight direction

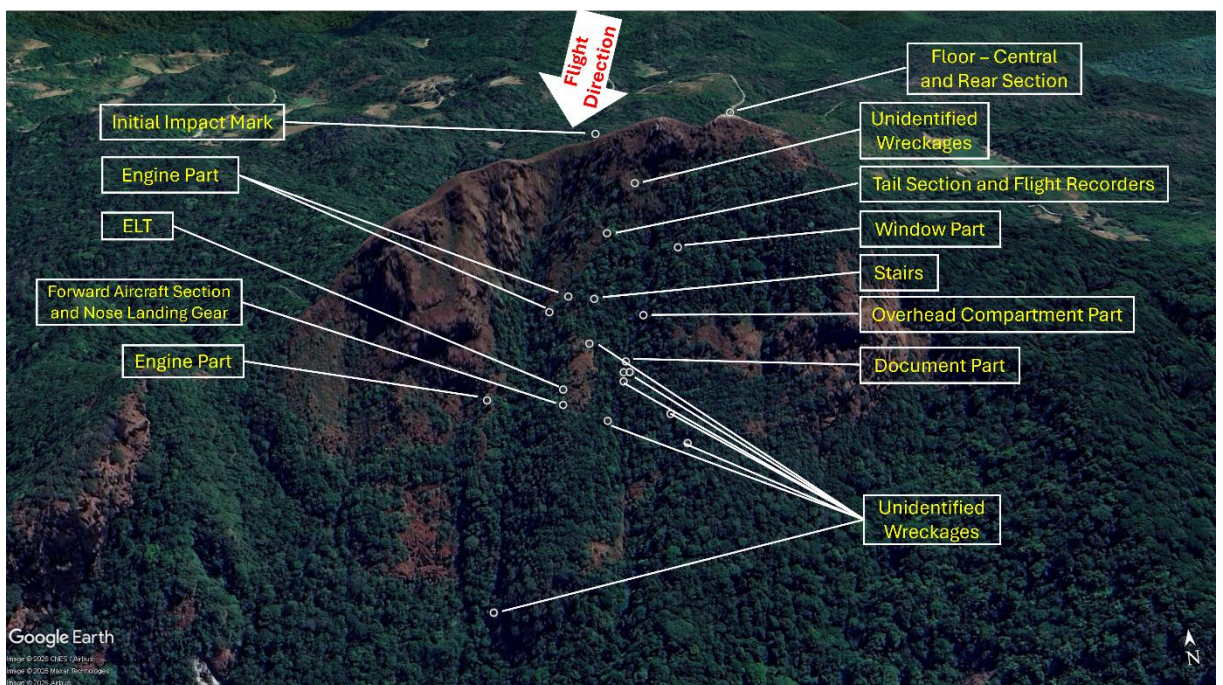


Figure 11: The wreckage distribution

1.13 Medical and Pathological Information

This information was not available at the time of the issuance of this report. Should any medical and/or pathological information be obtained in the course of this investigation that is of relevance to this investigation, it will be included in the final report.

1.14 Fire

There was no evidence of in-flight fire, and the several wreckagees showed an indication of post-impact fire.

1.15 Survival Aspects

The search and rescue mission was immediately activated after the ATS provider notified the Indonesia Search and Rescue Agency (BASARNAS), and on 18 January 2026, the aircraft was found scattered on the Mount Bulusaraung. The accident was not survivable.

1.16 Tests and Research

This information was not available at the time of the issuance of this report. Should any test and research information be obtained in the course of this investigation that is of relevance to this investigation, it will be included in the final report.

1.17 Organizational and Management Information

1.17.1 Aircraft Operator

The aircraft was owned and operated by IAT which held a valid Air Operator Certificate.

The aircraft operator is authorized to conduct Supplemental, On-Demand Airplane, and On-Demand Rotorcraft for the carriage of passengers and cargo in non-scheduled operations.

The aircraft operator operated a total of one ATR 42-500 (the accident aircraft), two Embraer Legacy 600 or Legacy 650 (EMB 135BJ), and two Airbus EC 155B1 helicopters.

1.17.1.1 Policy to Use Headsets and Boom Microphone

The aircraft operator Operation Manual Part A: General (OM-A) subchapter 9.2.4 described the mandatory use of headsets and boom microphone during critical phase of flight as follows:

During high workload, especially under emergency conditions, good and swift communication is very important. This purpose is best served through the use of earphones, keeping one ear uncovered. Internal communication and external transmissions must be kept separated, and avoid unnecessary delays in transmission.

During ground activities, taxi, takeoff until the top of climb and from the start of descent throughout approach and landing, flight crewmember shall use headsets and/or boom microphone.

During cruise, flight deck speakers may be used. Speaker volume should be kept at the minimum usable level adequate to avoid interference with normal crewmember flight deck conversation, but still ensure reception of relevant communications.

...

1.17.1.2 Navigation Procedures

FCOM Subchapter NOR.7.3 requires pilots to do several actions during cockpit preparations, including checking the aircraft GPS/GNSS. In the event of DGR alarm display is identified (see [Subchapter 1.8.1](#)), the FCOM Subchapter NSU.34.4.3 states:

In the event of DGR alarm display the flight crew must X check the aircraft position using conventional means or must revert to an alternative means of navigation.

1.17.2 Air Traffic Services Provider

Air traffic services (ATS) in Indonesia are provided by Perum Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia (AirNav Indonesia). The air traffic control (ATC) services within Ujung Pandang Terminal Control Area (TMA) and Ujung Pandang Control Area (CTR) are provided by the AirNav Indonesia branch office, Makassar Air Traffic Service Center (MATSC), which held a valid ATS provider certificate.

The ATC service provided by MATSC utilized the TopSky–ATC system developed by Thales, a French public limited company. The TopSky–ATC system has been used as the surveillance system in MATSC since 2015.

The TopSky–ATC system has several surveillance alert capabilities, including Minimum Safe Altitude Warning (MSAW). The MSAW alerts the ATCO if an aircraft is going to infringe one of the predefined MSAW areas within predefined parameters.

The MSAW areas consist of Terrain Hazards and Obstacles. The Terrain Hazards are defined as rectangular geographic areas using coordinates. Each rectangular area is approximated using fine mosaic grid square cells, and each cell is assigned a minimum safe altitude. The cells that do not have a defined minimum safe altitude are considered unused. The Obstacles areas are defined as cylinders**,** and a center radius and minimum safe altitude must be defined for each. Different cylinders are stacked to provide a representation similar to a relief model of the obstacles as defined by different contour levels. The system also has the capability to define an inhibition zone (such as final approach zones) in which surveillance tracks will not be subject to MSAW processing.

The predefined MSAW parameters include:

- Look-ahead Time: determine how far ahead of the current time the system will check for possible entry into MSAW areas;
- Warning Time: determine how far ahead of possible entry into MSAW areas a warning will be displayed to the controller. The value must be less than the look ahead time;
- Intensity Threshold: number of successive predictions of MSAW infringement before a warning will be generated.

- Rate Threshold: the maximum rate of descent of an aircraft for which the Cleared Flight Level (CFL) may be considered as a valid limit when predicting entry into MSAW areas
- Level Threshold: the maximum difference between the actual track level and the CFL that would allow the CFL to be considered as a valid limit when predicting entry into MSAW areas.
- Update Period: the number of radar track updates for each MSAW processing update.
- IFR Altitude Margin: vertical safety margin for IFR flights over MSAW Hazards (Obstacles & Terrains).
- IFR Activation Message (ACT): indicates whether MSAW alert processing should consider IFR flights. If FALSE, means that IFR tracks are considered for MSAW alert processing.
- Eligibility means the eligibility conditions of system tracks for MSAW processing. If Fpdata_ALL, the system will only consider coupled tracks only and flight plan data in eligibility conditions.

Based on the data set for MSAW, the predefined MSAW areas and parameters have not been updated since 2015. The MSAW areas (Terrain Hazards, Obstacle and Inhibition areas) had not been set and the MSAW parameters were as follows:

Parameters	Value for Radar track	Value for ADSB track
MSAW_LOOK_AHEAD_TIME	90 seconds	90 seconds
MSAW_WARNING_TIME	60 seconds	60 seconds
MSAW_INTENSITY_THRESHOLD	2	2
MSAW_RATE_THRESHOLD	2,000 feet per minute	2,000 feet per minute
MSAW_LEVEL_THRESHOLD	1,000 feet	1,000 feet
MSAW_UPDATE_PERIOD	2	2
MSAW_IFR_ALTITUDE_MARGIN	0 feet	0 feet
MSAW_IFR_ACT	FALSE	FALSE
MSAW_ELIGIBILITY	FPDATA ALL	FPDATA ALL

1.17.3 Civil Aviation Authority

The safety oversight on civil aviation in Indonesia is administered by the Directorate General of Civil Aviation (DGCA) which is part of the Ministry of Transportation. The requirement standards for civil aviation safety in Indonesia are published in the Civil Aviation Safety Regulation (CASR) and Directorate General (DG) regulations.

CASR Part 170: Air Traffic Rules, Subchapter 3.11 requires radar and ADS-B ground systems to provide for the display of safety-related alerts and warnings, including minimum safe altitude warning.

Manual of Standards (MOS) Part 170-01: ATS Operational Procedures Subchapter 15.7.4 states that generation of MSAW is a function of an ATC radar data-processing system. The objective of the MSAW function is to assist in the prevention of controlled flight into terrain accidents by generating, in a timely manner, a warning of the possible infringement of a minimum safe altitude. In the MSAW function, the reported

levels from aircraft with pressure-altitude reporting capability are monitored against defined minimum safe altitudes. When the level of an aircraft is detected or predicted to be less than the applicable minimum safe altitude, an acoustic and visual warning will be generated to the controller within whose jurisdiction area the aircraft is operating. In the event an MSAW is generated in respect of a controlled flight being vectored, the ATSO must without delay instruct the pilot to climb immediately to the applicable safe level and, if necessary to avoid terrain, be assigned a new heading.

MOS CASR 171-02: Technical Specification of Aeronautical Telecommunication Facility, Subchapter 3.5.2.3.11.3 requires ATC automation to have the capability to generate MSAW with respect to tracks providing Secondary Surveillance Radar (SSR) Mode C²⁰ information. A MSAW will be generated when SSR Mode C information indicates that an aircraft:

- in level flight is inside or within (adaptable) NM of an area where the minimum safe flight level is greater than the aircraft flight level;
- has a rate of descent (adaptable time) indicating that a minimum safe altitude will be penetrated;
- has a rate of climb (adaptable time) insufficient to obtain a minimum safe altitude.

According to the Director General Regulation No. KP 182 of 2017, the safety oversight for air navigation would be conducted by air navigation inspector through audit, inspection, surveillance and monitoring. During the oversight activities, the air navigation inspector must use protocol questions described in DG Regulation No. PR 3 of 2023. The MSAW-related protocol question is described as follows:

No.	Reference	Protocol Question	Guidance for Review
56	MOS 170-01	Is the surveillance system able to display safety-related alerts and warning, including conflict alert, minimum safe altitude warnings, conflict predictions and unintentionally duplicated SSR Code and aircraft identification?	Check the standard operating procedure (SOP) and user manual, and operation of the surveillance system.

In 2024 and 2025, the full scope air navigation audit for MATSC indicated that the protocol question number 56 remarked as satisfactory. The collected evidence to satisfy the protocol question was limited to the availability of ATS SOP that described the ATC automation has the capability to generate MSAW.

1.18 Additional Information

The investigation involved the participation of the *Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile* (BEA) France as the State of Design and the State

²⁰ SSR Mode C is a Secondary Surveillance Radar (interrogation mode used to automatically report an aircraft's pressure altitude (flight level) to ATC surveillance system.

of Manufacture, and the National Transportation Safety Board (NTSB) of the United States of America as the State providing assistance. Both agencies have appointed their accredited representatives to assist in this investigation in accordance with the provisions in ICAO Annex 13.

The investigation is ongoing and will continue to focus on, but is not limited to the following:

- aircraft navigation system
- understanding the cause of the GNSS degraded mode
- understanding the cause of the difference information of the aircraft position recorded in the FDR and broadcasted through ADS-B.
- human factors related issues that can degrade pilot and ATCO performance
- reviewing organizational issues in this occurrence.

Should any further relevant safety issues emerge during the course of the investigation, KNKT will immediately bring the issues to the attention of the relevant parties and publish them as required.

1.19 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with the KNKT approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 FINDINGS

The findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal or indicate deficiencies. Some findings point out the conditions that pre-existed the accident sequence, but they are usually essential to the understanding of the occurrence, usually in chronological order.

In this occurrence, KNKT identified several findings as follows:

1. The aircraft had a valid Certificate of Airworthiness (C of A) for transport category and a valid Certificate of Registration (C of R) and was operated within the weight and balance envelope.
2. Both pilots held valid licenses and medical certificates and were qualified as ATR 42-500 pilot.
3. Air Traffic Controller (ATCO) and planner (assistant controller) on duty held valid licenses, medical certificates, and approach control surveillance ratings.
4. The Global Navigation Satellite System (GNSS) installed in the aircraft was the HT1000 Global Navigation Management System (HT1000 system) that provides the three-dimensional (latitude, longitude, altitude) location and navigation means to the aircraft. Having the HT1000 System, the aircraft had the capability to conduct Performance Based Navigation (PBN).
5. At the time of the occurrence, the aircraft had an updated navigation database.
6. The aircraft was installed with Enhanced Ground Proximity Warning System (EGPWS) that performs several alert modes, including Enhanced Modes: Terrain and Obstacle Awareness, and Basic EGPWS Modes: Mode 2 - Excessive Terrain Closure Rate.
7. When the HT1000 system enters a degraded mode, the DGR amber alarm will be displayed on the Electronic Horizontal Situation Indicator (EHSI) – a display in the cockpit that can be used by the pilot to indicate the aircraft position.
8. The applicable Flight Crew Operating Manual (FCOM) describes that DGR illuminates in amber on the EHSI when the “UNABLE RNP” message is displayed in the MCDU. The “UNABLE RNP” message displayed in the MCDU can trigger an External System Warning “RNV MSG (1)” in the Electronic Attitude Director Indicator (EADI).
9. The FCOM describes that the “UNABLE RNP” message will be annunciated when Actual Navigation Performance (ANP) does not meet the Required Navigation Performance (RNP) or when the integrity is greater than twice the selected RNP.
10. The FCOM requires pilots to perform several actions during cockpit preparations, including checking the aircraft GPS/GNSS. In the event that a DGR alarm display is identified the pilot must cross check the aircraft position using conventional means or revert to an alternative means of navigation.
11. The Enhanced Modes of Terrain and Obstacle Awareness of the EGPWS use aircraft geographic position provided by an aircraft GPS or an optional internal

GPS card, aircraft altitude and worldwide terrain database to predict potential conflicts between the aircraft flight path and the terrain, and to provide aural alert and graphic displays of the conflicting terrain.

12. When the aircraft penetrates the caution envelope boundary, the Enhanced Modes of Terrain and Obstacle Awareness of the EGPWS generate an aural message “TERRAIN AHEAD - TERRAIN AHEAD” or “OBSTACLE AHEAD - OBSTACLE AHEAD” (for obstacle detection), and the red GPWS warning lights illuminate on each instrument panel.
13. The Basic EGPWS Mode 2 calculates an excessive terrain closure rate using the radio altimeter. When the aircraft penetrates the envelope, the system generates a “TERRAIN - TERRAIN” voice alert, and the red GPWS warning lights illuminate on each instrument panel. If the aircraft continues to penetrate the envelope, the “PULL UP” voice alert will be generated, with the red GPWS lights remaining illuminated.
14. The ATCO provided air traffic control (ATC) services utilizing the TopSky – ATC system, a surveillance system that has been used since 2015.
15. The TopSky – ATC system has several surveillance alert capabilities including Minimum Safe Altitude Warning (MSAW). The MSAW alerts the ATCO if an aircraft is going to infringe on one of the predefined MSAW areas within predefined parameter.
16. Based on the data set for MSAW, the predefined MSAW areas and parameters have not been updated since 2015. The MSAW areas (Terrain Hazards, Obstacles and Inhibition areas) had not been set and the MSAW parameters while the MSAW parameters were set with several predefined parameters.
17. Ground Automatic Dependent Surveillance–Broadcast (ADS-B) receivers were installed in several places in Indonesia, including at the location that received ADS-B data from PK-THT during the accident flight. The ADS-B data were utilized by the air traffic services (ATS) provider in its surveillance system to display the aircraft target on the ATCO situation display.
18. Runway 21 of Sultan Hasanuddin International Airport is equipped with an Instrument Landing System (ILS) that provides lateral (localizer) and vertical (glideslope) position information using angular deviation signals from the localizer and glideslope antennas. At the time of the occurrence, the ILS was reported to be functioning normally.
19. AIP Volume II, Subchapter WAAA AD 2.24-10, contained the Air Traffic Control Surveillance Minimum Altitude Chart (SMAC), which provides information on minimum altitudes in certain areas as a reference for the ATCO when providing altitude clearance. The accident site (Mount Bulusaraung) was within an ATC SMAC of 6,000 feet.
20. The aircraft was operated for an aerial surveillance mission over four areas (Surveillance Point 1 to 4).
21. When the engine had been started and the FDR began to record the flight data, the parameter of the GNSS HT1000 Degrade was recorded as Degrade. GNSS

HT1000 Degraded Mode means that the GPS accuracy or integrity was compromised. In this case, the pilot should not navigate the aircraft using the satellite system.

22. When the Flight Data Recorder (FDR) began to record the flight data, the parameter of the Global Navigation Satellite System (GNSS) Degrade was recorded as Degrade, and the recorded coordinates indicated that the aircraft was 1 NM southeast of Adisutjipto Airport. The recorded aircraft coordinate in the FDR was the aircraft position displayed in the EHSI.
23. The ground receiver of Automatic Dependent Surveillance–Broadcast (ADS-B) started to receive the broadcasted data from the aircraft when the aircraft was at an altitude of 5,900 feet.
24. At the time the ADS-B ground receiver recorded the aircraft data, the position of the aircraft was about 0.6 NM northwest of the aircraft position recorded in the FDR, and the distance continued to reduce (the aircraft trajectory from FDR data was getting closer to the trajectory from ADS-B data).
25. At 0114 UTC, when the aircraft passed an altitude of 7,700 feet, the GNSS Degrade parameter recorded Not Degrade, and a few minutes later, the aircraft trajectories from FDR and ADS-B data were superimposed.
26. At 0143 UTC, the GNSS Degrade parameter recorded Degrade, and it remained so until the end of the FDR recording.
27. At 0145 UTC, the aircraft trajectory from FDR data and ADS-B data started to split when the aircraft conducted aerial surveillance near Surveillance Point 1. The distance between the two trajectories was increasing.
28. At 0204 UTC, the aircraft descended to an altitude of about 1,500 feet to conduct aerial surveillance near Surveillance Point 2. After completing the aerial surveillance, the aircraft climbed to an altitude of 2,000 feet and continued flying to the next aerial surveillance area.
29. CVR data indicated that the SIC was the PM and the PIC was the PF when they made initial contact with the ATCO of Ujung Pandang Terminal Control Area (TMA).
30. When the PM reported to the ATCO that the aircraft would fly to the last aerial surveillance area, the FDR data showed the aircraft was about 18 NM west of Surveillance Point 4, while the ADS-B data showed the aircraft was about 22 NM southwest of Surveillance Point 4. The distance between the two aircraft trajectories was about 14 NM.
31. When the PM reported to the ATCO that the aircraft was on heading 083° to Waypoint DAKAD, the FDR data showed that the aircraft was about 10 NM west of Waypoint DAKAD, while the ADS-B data showed that the aircraft was about 17 NM southwest of Waypoint DAKAD. The distance between the two aircraft trajectories was about 15 NM. When the PM reported to the ATCO that the aircraft was tracking to the Waypoint DAKAD on heading 083° about 0.9 NM from DAKAD, the FDR data showed the aircraft was about 1 NM west of Waypoint DAKAD, while the ADS-B data showed the aircraft was about 15 NM southeast

of Waypoint DAKAD. The distance between the two aircraft trajectories was about 15 NM.

32. The ATCO intended to advise the PK-THT pilot that the aircraft was far from Waypoint DAKAD using the phrase “*DAKAD your not, not point*” and instructed the aircraft to turn left to heading 360° for sequencing. The PM read back only the turning instruction
33. At 0411 UTC, the ATCO instructed the PK-THT pilot to turn to the left direct to Waypoint ARAJA and issued approach clearance to Runway 21 using the ILS. The PM acknowledged the ATCO instruction.
34. The ATCO noticed on his situation display that the PK-THT target did not track to Waypoint ARAJA, and at 0416 UTC, the ATCO instructed the PK-THT pilot using the phrase “*vector to OPENG turn left heading 125°*”, and the PM responded, “*turn left heading 125°*”.
35. When the PK-THT target was flying past abeam Waypoint OPENG, the ATCO communicated with several other pilots providing ATC services, and when there was no communication with the other pilots, the ATCO and a supervisor from another sector had non-duty-related discussion.
36. The PM confirmed to the ATCO whether the aircraft was still maintaining heading 125° and an altitude of 5,000 feet when the aircraft had passed abeam Waypoint OPENG. The ATCO then instructed the PK-THT pilot to turn to the right, direct to Waypoint KABIB, and descend to an altitude of 3,200 feet.
37. At 04:22:24 UTC, the ATCO situation display indicated that the PK-THT target did not head to Waypoint KABIB, and the ATCO instructed the PK-THT pilot to turn to the right proceeding to final.
38. When the PM reported to the ATCO that the aircraft was headed to Waypoint KABIB the FDR data showed the aircraft was about 16 NM northeast of Waypoint KABIB while the ADS-B data showed the aircraft was about 6 NM east of Waypoint KABIB.
39. The MSAW from the ATC surveillance system did not activate when the PK-THT target was below the minimum safe altitude described in the ATC Minimum Surveillance Altitude Chart (SMAC).
40. About 0422 UTC, the aircraft’s EGPWS generated aural alerts “TERRAIN - TERRAIN” followed by “PULL UP” four times. The CVR stopped recording soon after the EGPWS warnings.
41. At 0423 UTC, the PK-THT target on the ATCO situation display changed from a surveillance target to a flight plan target. This condition indicated that the surveillance system did not receive PK-THT surveillance data.
42. The assistant controller went to the rest room at about 0410 UTC and returned to CWP a few moments after the ATC surveillance system did not receive PK-THT surveillance data.
43. All communications between the ATCO and the pilot were recorded by ground-based automatic voice recording equipment and the Cockpit Voice Recorder in the aircraft. The quality of the aircraft’s recorded transmissions was good.

44. The unintelligible pilot discussion recorded in the Cockpit Area Microphone channel in the CVR indicated that both pilots did not use headsets and boom microphones during the accident flight.
45. The weather radar and satellite imagery at 0420 UTC indicates the presence of convective cumulonimbus clouds around the accident site.
46. The initial impact location was at the coordinates of 4°55'44.37" S; 119°44'50.008" E at an elevation of about 4,300 feet AMSL. The wreckage was scattered about 700 × 200 meters on the slope of about 80°.
47. There was no evidence of in-flight fire, and the several wreckages showed an indication of post-impact fire.
48. The aircraft operator Operation Manual Part A: General (OM-A) required pilots to use headsets and/or boom microphones during ground activities, taxi, takeoff until the top of climb and from the start of descent throughout approach and landing.
49. Civil Aviation Safety Regulation (CASR) Part 170: Air Traffic Rules requires radar and ADS-B ground systems to provide for the display of safety-related alerts and warnings, including minimum safe altitude warning.

3 SAFETY ACTION

At the time of issuing this investigation report, KNKT had been informed of any safety actions resulting from this occurrence.

3.1 Directorate General of Civil Aviation

The safety actions taken by the Directorate General of Civil Aviation (DGCA) were as follows:

1. Issued Circular Letter number SE-DJPU 2 Tahun 2026, which included directives for pilots, aircraft operators, and ATS providers to adhere the applicable operational procedures and guidelines, including:
 - Every pilot must adhere to the prevailing minimum safe altitude requirements.
 - The flight plan should be conducted comprehensively, including consideration of the weather, terrain characteristics, and flight rules applicable to the flight.
 - Pilots must implement applicable TAWS procedures
 - Aircraft operators must provide operational procedures and guidelines regarding minimum safe altitude compliance, including internal oversight to ensure their effective implementation.
 - Aircraft operators must ensure that the terrain database must be updated in accordance with manufacturer recommendations.
 - ATS providers must ensure that the surveillance system can generate alerts and warnings, including MSAW
 - ATS providers must ensure that descent clearance/instruction issued by the ATCO is not below the determined minimum safe altitude.
2. Issued Circular Letter number SE-DJPU 4 Tahun 2026, which included directives as follows:
 - When there is an indication of navigation system degradation, pilots are required to verify the aircraft position using conventional means and/or revert to an alternative means of navigation in accordance with the applicable operational procedure.
 - The aircraft operator is required to report to the KNKT and DGCA when identifying any difference in position information recorded in the FDR and ADS-B data.
 - The aircraft operator must ensure that pilots implement applicable operational procedures when there is an indication of navigation system degradation.
3. Issued a directive to all DGCA regional offices to conduct safety oversight of all ATC units that utilize surveillance systems, to ensure that the provision of ATC services has been conducted in accordance with the applicable standard operating procedures. The directives also included checking the MSAW dataset to ensure that the MSAW is generated in accordance with the applicable minimum safe altitude.

- In progress to revise the oversight protocol question by adding detailed guidance for reviewing the MSAW-related protocol question. The guidance includes a requirement for inspectors to check the MSAW dataset to ensure that the MSAW is generated in accordance with the applicable minimum safe altitude.

3.2 AirNav Indonesia

The safety actions taken by the ATS provider were as follows:

- The MSAW dataset was updated in accordance with the ATC SMAC.
- Issued an Operation Director Instruction that highlighted the implementation of instrument approach procedure for ATCO. The instruction included reminder to ensure that descent clearance/instruction is not below the determined minimum safe altitude.
- Professional Work Rhythm Procedures were revised to include prohibition for ATCO to have a non-duty-related discussion when on duty providing air traffic control services.
- Reminded ATCOs on branch office MATSC to watch closely aircraft that are approaching Runway 21, and immediately issued instruction/clearance to cancel the approach if there is a deviation.
- Instrument approach procedure for ILS Runway 21 of Sultan Hasanuddin International Airport was revised from ILS conventional (S-Type) to RNP/ILS (Track to Fix). The revised instrument approach procedure will be effective on 19 March 2026.

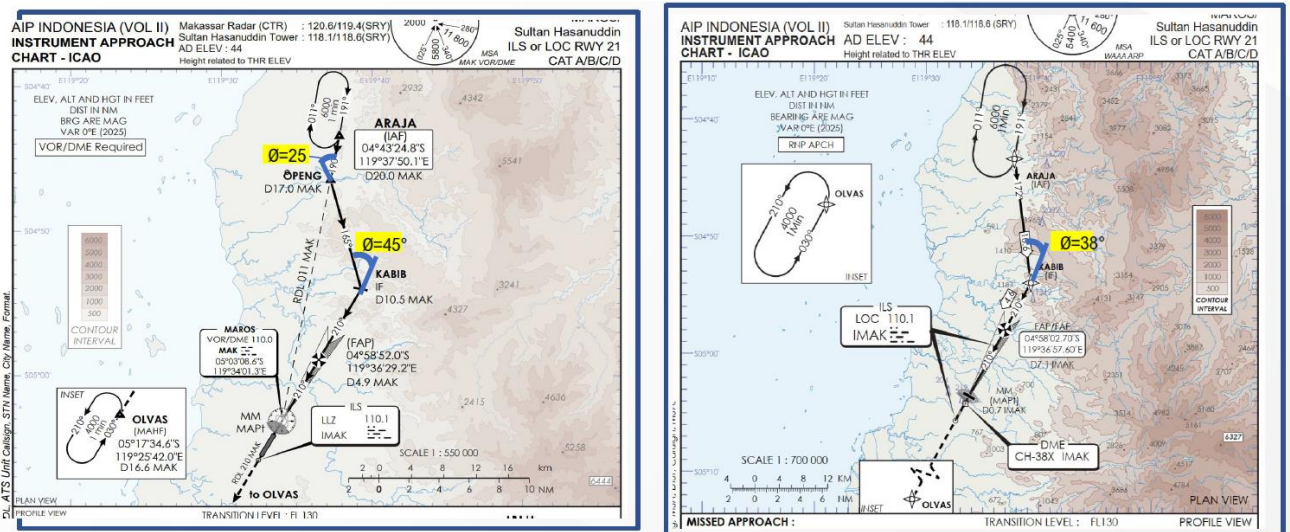


Figure 12: The previous (left) and revised (right) instrument approach procedure for ILS Runway 21

3.3 Indonesia Air Transport

The safety actions taken by the aircraft operator were as follows:

1. Issued safety notice number IAT/QSSD/2026/SN-03 emphasizing mandatory usage of headsets and boom microphone to the flight crew during ground operation, taxi, takeoff, climbing to Top of Climb (TOC), Start of Descend (SOD), approach and landing
2. Conducted the operation and safety meeting with all flight crew to emphasize the mandatory usage of headsets and microphones during the flight as described in the Operation Manual Part A Section 9.2.4 sterile cockpit and safety notice number IAT/QSSD/2026/SN-03.
3. Issued engineering notice number EN-IAT-FW/RW-26-002 to maintain and ensure the functionality and condition of headsets and boom microphones, and this equipment is required to be checked during pre-flight and post flight.

4 SAFETY RECOMMENDATIONS

KNKT acknowledges the safety actions taken by the related parties and considers that the safety actions were relevant to improving safety. Should any further relevant safety issues emerge during the course of the investigation, KNKT will immediately bring the issues to the attention of the relevant parties and publish as required.

KOMITE NASIONAL KESELAMATAN TRANSPORTASI REPUBLIK INDONESIA

Jl. Medan Merdeka Timur No.5 Jakarta 10110 INDONESIA

Phone : (021) 351 7606 / 384 7601 Fax : (021) 351 7606 Call Center : 0812 12 655 155

website 1 : <http://knkt.dephub.go.id/webknkt/> website 2 : <http://knkt.dephub.go.id/knkt/>

email : knkt@dephub.go.id