



**KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA**

FINAL

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Aircraft Serious Incident Investigation Report

**PT. Batik Air Indonesia and PT. Lion Mentari Airlines
Airbus A320-200; PK-LUI and Boeing 737-900ER; PK-LPF**

Near Waypoint TIRUS, Surabaya, East of Java

Republic of Indonesia

6 January 2018

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This Final 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 based upon the investigation carried out 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).

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Jakarta, October 2018

**KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN**



SOERJANTO TJAHOJONO

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ABBREVIATIONS AND DEFINITIONS

| | | |
|--------|---|---|
| AOC | : | Airline Operator Certificate |
| ATC | : | Air Traffic Control |
| ATPL | : | Airline Transport Pilot License |
| ATS | : | Air Traffic Services |
| C of A | : | Certificate of Airworthiness |
| C of R | : | Certificate of Registration |
| CASR | : | Civil Aviation Safety Regulation |
| CTR | : | Control Zone |
| CVR | : | Cockpit Voice Recorder |
| FAA | : | Federal Aviation Administration |
| FCU | : | Flight Control Unit |
| FDR | : | Flight Data Recorder |
| FL | : | Flight Level |
| FRMS | : | Fatigue Risk Management System |
| ICAO | : | International Civil Aviation Organization |
| KNKT | : | <i>Komite Nasional Keselamatan Transportasi</i> |
| LT | : | Local Time |
| OM-A | : | Operation Manual Volume A |
| PF | : | Pilot Flying |
| PIC | : | Pilot in Command |
| PM | : | Pilot Monitoring |
| RA | : | Resolution Advisory |
| SIC | : | Second in Command |
| STCA | : | Short Term Conflict Alert |
| TA | : | Traffic Advisory |
| TMA | : | Terminal Control Area |
| T-SOP | : | Temporary Standard Operating Procedures |
| UTC | : | Universal Coordinated Time |

SYNOPSIS

On 6 January 2018, a Boeing 737-900ER aircraft registered PK-LPF was being operated by PT. Lion Mentari Airlines (Lion Air) as a schedule passenger flight from Sentani International Airport (WAJJ), Papua, to Juanda International Airport (WARR), Surabaya with flight number of LNI3795 (LNI).

On the same day, an Airbus A320-200 aircraft registered PK-LUI was being operated by PT. Batik Air Indonesia (Batik Air) as a schedule passenger flight from Sultan Hasanuddin International Airport (WAAA), Makassar to Surabaya with flight number of BTK6137 (BTK).

Prior to the departure there was no report or record of both aircraft system malfunction and the flights were uneventful until the approach phase to Surabaya.

Both aircraft entered Surabaya East Terminal Control Area (TMA East) and the provision of air traffic services in TMA East was utilizing surveillance system (radar service). There was no report or record of radar system malfunction while providing the air traffic services for both aircraft.

Both aircraft pilots was instructed to join holding pattern over waypoint TIRUS for landing sequence. The controller instructed a step descend clearance for both pilots while the aircraft commencing to join holding pattern.

At 0316 UTC (1016 LT), the controller instructed the LNI pilot to descend to altitude of 10,000 feet. One minute later when the controller instructed the BTK pilot to descend to altitude of 11,000 feet. All controller instructions were read back properly by both pilots.

At 10:20:15 LT, the BTK passed altitude of 11,000 feet while the LNI was maintaining on altitude 10,000 feet and then the Short-Term Conflict Alert (STCA) of the controller radar system for LNI and BTK activated with aural and visual alert.

The closest distance of both aircraft laterally was about 1.9 Nm and vertically was about 600 feet. The separation regained after the activation of the TCAS RA warning which followed by the BTK pilot and the LNI pilot descended the aircraft. The horizontal separation returned to the required standard after passed 5 Nm.

The investigation determined that the aircraft and controller radar serviceability was not issue in this occurrence. Therefore, the analysis discussed the aircraft separation and pilot attention. The investigation concluded the contributing factor of the accident was:

- The vertical separation reduced to below the requirement due to the target altitude of BTK aircraft was set to 10,000 feet, which made the aircraft passed the assigned altitude.
- The unrecovered fatigue and family issue reduced the pilot awareness during less cockpit activity, resulted in reduced the ability to monitor other traffic and misunderstanding of assigned altitude.

Following the investigation, the Komite Nasional Keselamatan Transportasi (KNKT) was informed several safety actions taken by Batik Air. The KNKT acknowledges the safety actions however there still remain safety issues that need to be considered. Therefore, the KNKT issues safety recommendations addressed to the Batik Air and Directorate General of Civil Aviation (DGCA).

1 FACTUAL INFORMATION

1.1 History of the Flight

On 6 January 2018, a Boeing 737-900ER aircraft registered PK-LPF was being operated by PT. Lion Mentari Airlines (Lion Air) as a schedule passenger flight from Sentani International Airport (WAJJ), Papua¹, to Juanda International Airport (WARR), Surabaya² with flight number of LNI3795 (LNI).

On daylight condition, the LNI departed from Sentani. The Pilot in Command (PIC) acted as Pilot Monitoring (PM) and the Second in Command (SIC) acted as Pilot Flying (PF).

On the same day, an Airbus A320-200 aircraft registered PK-LUI was being operated by PT. Batik Air Indonesia (Batik Air) as a schedule passenger flight from Sultan Hasanuddin International Airport (WAAA), Makassar³ to Surabaya with flight number of BTK6137 (BTK). The PIC acted as PM and the SIC acted as PF. This flight was the second flight of the day which was also the last flight for the flight crew. The route was from Rendani Airport (WAUU), Manokwari⁴ – Makassar – Surabaya.

Prior to the departure there was no report or record of both aircraft system malfunction and the flights were uneventful until the approach phase to Surabaya.

Both aircraft entered Surabaya East Terminal Control Area (TMA East) and the provision of air traffic services in TMA East was utilizing surveillance system (radar service). There was no report or record of radar system malfunction while providing the air traffic services for both aircraft.

The pilots of both aircraft made initial contact to the controller and the TMA East air traffic controller (controller) instructed to join holding pattern over waypoint TIRUS⁵ for landing sequence. The controller instructed a step descend clearance for both pilots while the aircraft commencing to join holding pattern.

At 0316 UTC (1016 LT⁶), the controller instructed the LNI pilot to descend to altitude of 10,000 feet and then set the target altitude on the controller radar system to 10,000 feet for the LNI flight. One minute later when the controller aircraft situational display (radar display) showed the LNI passed altitude of 10,300 feet, the controller instructed the BTK pilot to descend to altitude of 11,000 feet and then set the target altitude on the controller radar system to 11,000 feet for the BTK flight.

All controller instructions were read back properly by both pilots.

1 The Sentani International Airport (WAJJ), Papua will be named as Sentani for the purpose of this report.

2 The Juanda International Airport (WARR), Surabaya will be named as Juanda for the purpose of this report.

3 The Sultan Hasanuddin International Airport (WAAA), Makassar will be named as Makassar for the purpose of this report.

4 The Rendani Airport (WAUU), Manokwari will be named as Manokwari for the purpose of this report.

5 Waypoint TIRUS located about 40 Nm North West of Surabaya or on bearing 334° from SBR VOR/DME. The coordinate of waypoint TIRUS is 06°46'12.92"S; 112°28'23.79"E and the DBR VOR/DME is 7°22'26.18"S; 112°46'16.39"E.

6 The 24-hours clock in Local Time (LT) is used in this report to describe the time as specific events occurred. Local time is Universal Time Coordinated (UTC) +7 hours.

The BTK pilots noticed on the Traffic Collision Avoidance System (TCAS) display that there was LNI flight below and did not pay attention of its altitude. The BTK PM was aware that the aircraft was under radar surveillance control and believed that all aircraft would be controlled and separated by the controller.

The BTK PM advised the PF that the descend clearance was to altitude of 10,000 feet. The BTK pilots stated that during the descent, the cockpit condition was not busy as the flight was on direct flight to make holding over waypoint TIRUS using autopilot.

At 10:18:13 LT, when the BTK altitude passed 13,200 feet, the Flight Data Recorder (FDR) recorded that the target altitude selector on the Flight Control Unit (FCU) was set to 11,000 and one second later changed to 10,000 feet.

At 10:20:15 LT, the BTK passed altitude of 11,000 feet while the LNI was maintaining on altitude 10,000 feet and then the Short-Term Conflict Alert (STCA) of the controller radar system for LNI and BTK activated with aural and visual alert.

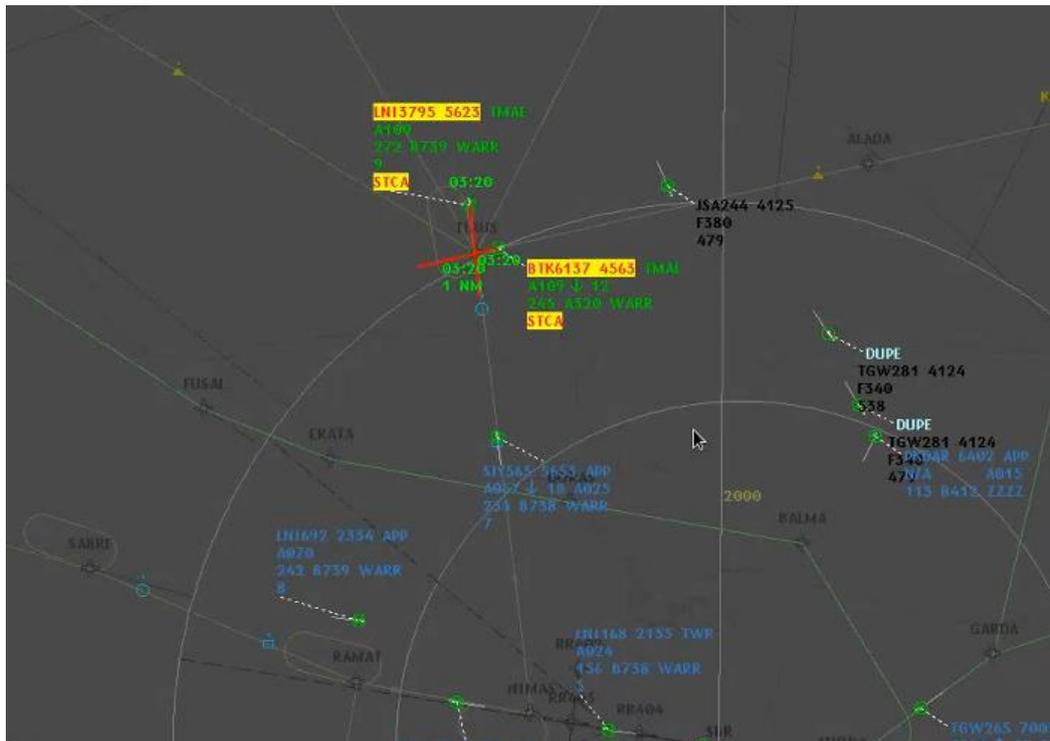


Figure 1: The STCA activated on the controller radar system at 10:20:15 LT

At 10:20:21 LT, the BTK pilot noticed TCAS Traffic Advisory (TA) on the aircraft navigation display with intruder below and maintained at altitude of 10,000 feet.

At 10:20:24 LT, the LNI pilot confirmed to the controller whether any traffic above. The controller then instructed the BTK pilot to maintain altitude of 11,000 feet with no respond.

At 10:20:35 LT, the LNI pilot noticed the TCAS Resolution Advisory (RA) warning followed with instruction “DO NOT CLIMB”, and one second later the BTK pilots received TCAS RA instruction “DO NOT DESCEND”. At about the same time, the controller instructed the BTK pilot to climb to altitude of 11,000 feet with no respond.

The LNI pilot descended the aircraft while the BTK pilot stopped the descent and maintained the aircraft at altitude of 10,500 feet.

At 10:20:40 LT, the LNI pilot advised the controller that the pilot received TCAS RA warning.

The closest distance of both aircraft laterally was about 1.9 Nm and vertically was about 600 feet at 10:20:57 LT.

At 10:20:53 LT, the BTK pilot confirmed to the controller that the instruction was to descend to altitude of 10,000 feet and the pilot had been read back the controller instruction. The TMA East controller responded that the instruction was to descend to altitude of 11,000 feet.

At 10:21:06 LT, the BTK pilot convinced to the controller that the read back was to descend to altitude of 10,000 feet and asked why the controller did not correct the read back if it was wrong. The controller advised the BTK pilot that the instruction to descend to altitude of 10,000 feet was for LNI pilot.

At 10:21:13 LT, the controller re-instructed the BTK pilot to maintain altitude of 11,000 feet and acknowledged.

There was no further significant event on both flights, the LNI landed at 1039 LT while the BTK at 1043 LT. The aircraft was undamaged and no one injured in this occurrence.

1.2 Personnel Information

1.2.1 BTK Pilots

Pilot in Command

The PIC is Malaysian, 48 years old that held valid Airline Transport Pilot License (ATPL), ICAO language proficiency and first-class medical certificate with limitation to wear lens to correct distant vision. The PIC qualified as Airbus A320-200 aircraft with flying experience as follows:

| | |
|---------------|-------------------|
| Total hours | : 15,869.88 hours |
| Total on type | : 6,750 hours |
| Last 90 days | : 222.87 hours |
| Last 30 days | : 74.17 hours |
| Last 24 hours | : 5.67 hours |
| This flight | : 1.45 hours |

The PIC joined Batik Air on 7 March 2016. The PIC was staying in Jakarta while his family was in Malaysia.

On 29 until 31 December 2017, the PIC took annual leave and back to Malaysia to resolve his family medical issue.

Second in Command

The SIC is Indonesian, 44 years old, held valid Airline Transport Pilot License (ATPL), ICAO language proficiency and a first-class medical certificate with limitation to possess glasses that correct for near vision. The SIC qualified as Airbus A320-200 aircraft with flying experience as follows:

| | |
|---------------|------------------|
| Total hours | : 2,812.48 hours |
| Total on type | : 2,662.48 hours |
| Last 90 days | : 252.67 hours |
| Last 30 days | : 86.42 hours |
| Last 24 hours | : 6.17 hours |
| This flight | : 1.45 hours |

The BTK pilot activity prior to the occurrence

On 4 January 2018, the pilots had overnight flight schedule from Soekarno-Hatta International Airport (WIII), Jakarta⁷ to Manokwari. The pilots signed on for the duty at 2210 LT, after approximately 4 hours 30 minutes flight, the pilots signed off at 5 January 2018 at 0640 LT. The local time in Manokwari was 2 hours ahead of Jakarta time.

After the flight, the pilots rested in a hotel in Manokwari. There was no significant physical activity during the rest period in Manokwari. Both pilots did not recall the duration of sleep they took that day.

On 6 January 2018, the pilots signed on for duty at 0605 LT and were scheduled for two flights from Manokwari – Makassar – Surabaya. The total flight hour from Manokwari to Makassar was approximately 2 hours 30 minutes. While transit in Makassar there was no significant physical activity for both pilots. The SIC stated that during the occurrence flight, he felt sleepy and the PIC mentioned that his family medical issue was still in his mind, especially when not many activity to be done.

1.2.2 LNI Pilots

Both pilots were Indonesian and qualified Boeing 737 NG aircraft that had valid license, ICAO language proficiency and medical certificate. The PIC had total flying hours of 6,603.3 hours while the SIC had 2,502.075 hours.

1.2.3 Air Traffic Controller

The air traffic controller was Indonesian and qualified approach radar controller for Surabaya TMA East. The controller had valid air traffic control license, ICAO language proficiency and medical certificate. The controller had working experience as air traffic controller for more than 20 years.

⁷ The Soekarno-Hatta International Airport (WIII), Jakarta will be named as Jakarta for the purpose of this report.

1.3 Aircraft Information

Both aircraft had a valid Certificate of Airworthiness and Certificate of Registration. There was no report or record of aircraft system malfunction during the occurrence.

Collision Avoidance Systems

Both aircraft were equipped with Traffic Collision Avoidance System (TCAS) which provides Resolution Advisories (RAs) in addition to Traffic Advisories (TAs). TCAS on both aircraft were serviceable.

1.4 Communications

All communications between controller and pilots were recorded by ground based automatic voice recording equipment for the duration of the flight. The quality of the recording transmissions was good. The significant excerpt from the recording equipment was as follows:

| Time (LT) | Event |
|-----------|--|
| 10:02:12 | The LNI pilot made initial contact to the controller and was instructed to descend to altitude of 16,000 feet and expected for approach to runway 10. The LNI pilot read back the instruction. |
| 10:04:18 | The BTK pilot made initial contact with the controller and was instructed to descend to altitude of 17,000 feet and expected for approach to runway 10. The BTK pilot read back the instruction. |
| 10:07:05 | The LNI pilot requested descend clearance to the controller and instructed to descend to altitude of 14,000 feet and to hold over waypoint TIRUS. The LNI pilot read back the instruction. |
| 10:08:37 | The controller instructed the BTK pilot to descend to altitude of 15,000 and the BTK pilot read back the controller instruction. |
| 10:09:36 | The controller instructed the LNI pilot to descend to altitude of 13,000 feet and the LNI pilot read back the controller instruction. |
| 10:10:52 | The controller instructed the LNI pilot to descend to altitude of 11,000 feet and the LNI pilot read back the controller instruction. |
| 10:11:02 | The controller instructed the BTK pilot to descend to altitude of 13,000 feet and to hold over waypoint TIRUS. The BTK pilot read back the controller instruction. |
| 10:16:57 | The controller instructed the LNI pilot to descend to altitude of 10,000 feet and the LNI pilot read back the controller. |
| 10:18:05 | The controller instructed the BTK pilot to descend to altitude of 11,000 feet and the BTK pilot read back the instruction to descend to 11,000 feet. |
| 10:20:24 | The LNI pilot confirmed to the controller whether any traffic above. |

| Time (LT) | Event |
|------------------|--|
| 10:20:29 | The controller instructed the BTK pilot to maintain altitude of 11,000 feet. The BTK pilot did not reply. |
| 10:20:35 | The controller instructed the BTK pilot to climb altitude of 11,000 feet. The BTK pilot did not reply. |
| 10:20:40 | The LNI pilot advised the controller that the pilot received TCAS RA and the controller acknowledged. |
| 10:20:46 | The controller re-instructed the BTK pilot to maintain altitude of 11,000 feet due to traffic was maintaining 10,000 feet. |
| 10:20:53 | The BTK pilot confirmed the controller that the instruction was to descend to altitude of 10,000 feet and the pilot had been read back the controller instruction. The TMA East controller responded that the instruction was to descend to altitude of 11,000 feet. |
| 10:21:06 | The BTK pilot convinced the controller that the read back was to descend to altitude of 10,000 feet and asked why the controller did not correct the read back if it was wrong. The controller responded that the instruction to descend to altitude of 10,000 feet was for LNI pilot. |
| 03:21:13 | The TMA East controller re-instructed the BTK pilot to maintain altitude of 11,000 feet and acknowledged. |
| 03:21:18 | The LNI pilot advised to the controller that the conflict had been cleared and was acknowledged. |

1.5 Flight Recorders

Both aircraft were equipped with Cockpit Voice Recorder (CVR) and Flight Data Recorder (FDR). The recorded voice communication on the both CVRs had overwritten.

The FDR of the BTK was L-3 FDR model with part number 2100-4245-00 and serial number 001149237, while the FDR of LNI was Honeywell FDR model with part number 980-4750-009 and serial number 03151.

The aircraft operators provided to the KNKT of the downloaded data of both FDR for analysis. The significant recorded parameters of the FDRs were as follows:

| Time (LT) | BTK | LNI | Separation⁸ |
|------------------|---|---|---|
| 10:18:13 | <ul style="list-style-type: none"> The target altitude selector on the FCU was changed from 13,000 feet to 11,000 feet. The altitude was reduced and passed 13,288 feet with vertical speed of -1050 fpm (aircraft descending). | The altitude was reduced and passed altitude of 10,371 feet with vertical speed of -688 fpm (aircraft descending). | Horizontal: 14.7 Nm Vertical: 2,900 feet |
| 10:18:14 | <ul style="list-style-type: none"> The target altitude selector on the FCU was changed from 11,000 to 10,000 feet. The altitude was reduced and passed 13,200 feet with vertical speed of -1,050 fpm (aircraft descending). | The altitude was reduced and passed altitude of 10,300 feet with vertical speed of -704 fpm (aircraft descending). | Horizontal: 14.6 Nm Vertical: 2,900 feet |
| 10:20:15 | The aircraft was descending and passed 11,000 feet. | The altitude maintained at 10,100 feet. | Horizontal: 4.4 Nm Vertical: 800 feet |
| 10:20:21 | <ul style="list-style-type: none"> TCAS TA activated. The aircraft was descending and passed 10,800 feet. The vertical speed was -1,200 fpm and the rate of descent reduced (aircraft descending). | The altitude was maintained at 10,100 feet. | Horizontal: 3.9 Nm Vertical: 700 feet |
| 10:20:35 | <ul style="list-style-type: none"> TCAS TA activated. The aircraft was descending and passed 10,600 feet. The vertical speed was -840 fpm and the rate of descent reduced (aircraft descending). | <ul style="list-style-type: none"> TCAS RA activated with “<i>DON’T CLIMB</i>” instruction. The altitude was maintained at 10,100 feet. | Horizontal: 2.8 Nm Vertical: 400 feet |

⁸ The separation was calculated from the recorded coordinates of both aircraft on the FDR.

| Time (LT) | BTK | LNI | Separation⁸ |
|------------------|---|---|--|
| 10:20:36 | <ul style="list-style-type: none"> • TCAS RA activated with “<i>DON’T DESCEND</i>” instruction. • The altitude maintained at 10,500 feet. | <ul style="list-style-type: none"> • TCAS RA activated with “<i>DON’T CLIMB</i>” instruction. • The altitude was maintained at 10,100 feet. | Horizontal: 2.7 Nm Vertical: 400 feet |
| 10:20:49 | <ul style="list-style-type: none"> • TCAS RA activated with “<i>DON’T DESCEND</i>” instruction. • The altitude was maintained at 10,500 feet. | <ul style="list-style-type: none"> • TCAS RA activated with “<i>DON’T CLIMB</i>” instruction. • The aircraft descended with vertical speed - 928 fpm. | Horizontal: 2 Nm Vertical: 500 feet |
| 10:20:55 | <ul style="list-style-type: none"> • TCAS RA activated with “<i>DON’T DESCEND</i>” instruction. • The altitude was maintained at 10,500 feet. | <ul style="list-style-type: none"> • The TCAS message “CLEAR OF CONFLICT”. • The altitude was maintained 9,900 feet. | Horizontal: 1.9 Nm Vertical: 600 feet |
| 10:20:56 | <ul style="list-style-type: none"> • The TCAS message “CLEAR OF CONFLICT”. • The altitude was maintained at 10,500 feet. | The altitude was maintained 9,900 feet. | Horizontal: 1.9 Nm Vertical: 600 feet |

1.6 Organizational and Management Information

1.6.1 AirNav Indonesia

The *Perusahaan Umum Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia* (AirNav Indonesia) is the Air Traffic Services (ATS) provider within Indonesia. The ATS in Surabaya is provided by AirNav Indonesia branch office Surabaya which held a valid Air Traffic Services provider certificate. The services provided were aerodrome control service; approach control service; aeronautical communication service; and flight information services.

The approach control service is provided by the Surabaya approach control unit and utilizing surveillance control (radar service). The Surabaya approach control unit divided the jurisdiction into three sectors – Control Zone (CTR), East Terminal Control Area (TMA East) and West Terminal Control Area (TMA West).

1.6.2 PT. Batik Air Indonesia

The PK-LUI aircraft was operated by PT. Batik Air Indonesia (Batik Air) which held a valid Air Operator Certificate (AOC) number 121-050. The Batik Air was operating several aircraft types consisted of 36 Airbus A320-200, one Airbus A330-200, eight Boeing 737-800 and six Boeing 737-900ER.

Operation Manual Volume A

The Batik Air had Operation Manual Volume A (OM-A) that described general policies, rules, standard and procedures in accordance with the national and ICAO regulation.

On chapter 6.5 of the OM-A described precaution of fatigue as follows:

Fatigue continues to be one of the most treacherous hazards to flight safety, as it may not be apparent to a pilot until serious errors are made. Fatigue is best described as either acute (short-term) or chronic (long-term).

A normal occurrence of everyday living, acute fatigue is the tiredness felt after long periods of physical and mental strain, including strenuous muscular effort, immobility, heavy mental workload, strong emotional pressure, monotony, and lack of sleep. Consequently, coordination and alertness, so vital to safe pilot performance, can be reduced. A acute fatigue is prevented by adequate rest and sleep, as well as by regular exercise and proper nutrition.

Chronic fatigue occurs when there is not enough time for full recovery between episodes of acute fatigue. Performance continues to fall off, and judgment becomes impaired so that unwarranted risks may be taken. Recovery from chronic fatigue requires.

The safest rule is not to fly as a crewmember if signs/symptoms of fatigues occur in daily activities.

Crewmembers should take adequate rest and sleep as well as regular exercise and proper nutrition.

The duty time limitation for flight operation with two pilots in the cockpit was described on chapter 7.2, as follows:

| Condition | Maximum Flight Duty Time ⁹ | Maximum Flight time ¹⁰ |
|----------------------------------|---------------------------------------|-----------------------------------|
| Within 24 consecutive hours | 14 hours | 9 hours |
| In any 7 consecutive days | NIL | 30 hours |
| In any calendar month | NIL | 110 hours |
| In any 12 calendar months period | NIL | 1,050 hours |

The pilot rest requirement was stated in the chapter 7.4 which requires pilot to be relieved from all further duty for at least 24 consecutive hours within any 7 consecutive days.

The chapter 8.3.3.2.3 described the acceptance of air traffic control (ATC) clearance as follows:

All ATC clearances must be fully understood. Where there is any doubt regarding either the intent or the content of an ATC clearance or ATC message by any flight crew member, clarification must be immediately obtained.

ATC clearances or instructions containing altitude/flight level, heading or route/waypoint changes or assignments, any clearance issued in areas of high terrain, as well as any clearance including instructions for holding short of a runway, must be received and understood by two flight crew members.

For this purpose, when receiving such clearances from ATC, the PF must first repeat to the PM the content of the received clearance. If the PM agrees with PF on the content of the received clearance, the PM then reads back clearance to the ATC on the assigned frequency.

When a clearance is received whilst a single pilot occupies a control seat, that pilot must request and read back a confirmation of the clearance details and must confirm to the second pilot on his return to a control seat.

1.6.3 PT. Lion Mentari Airlines

The PK-LPF aircraft was operated by PT. Lion Mentari Airlines (Lion Air) which held valid Air Operator Certificate (AOC) number 121-010. The Lion Air operated several aircraft types consisted of three Airbus A330-300, one Boeing 747-400, one Boeing 737-400, eight Boeing 737-8, 34 Boeing 737-800 and 68 Boeing 737-900ER.

⁹ The Flight Duty Time is the total elapsed time from the time a crewmember is required to report for duty to the time that crewmember has completed all official duties with respect to a flight or series of flights and is released for an official crew rest.

¹⁰ The Flight Time is the total elapsed time from the moment the aircraft first moves under its own power for the purpose of take-off, until the time it comes to rest at the end of the flight. The Batik Air considers block-off time to be start of push-back or commencement of flight (own power) whichever is earlier.

1.6.4 Indonesia Regulations for Separation Standard

Vertical Separation

The Indonesia Advisory Circular (AC) 170-02: Manual of Air Traffic Services Operational Procedures subchapter 5.3 mentioned that the vertical separation minimum shall be a nominal 1,000 feet below Flight Level (FL) 290.

Horizontal Separation

When surveillance systems are used (e.g. based on radar), the horizontal separation minimum prescribed by the AC 170-02 was 5 Nm, unless otherwise stated by the appropriate ATS authority. This minimum may be reduced by the appropriate ATS authority but not below:

- 3 Nm when the surveillance systems capabilities at a given location so permit; and
- 2.5 Nm between succeeding aircraft which are established on the same final approach track within 10 Nm of the runway threshold. A number of additional criteria must be met in order to apply this separation minimum.

According to the Temporary Standard Operating Procedures (T-SOP) of Airnav Indonesia branch office Surabaya the horizontal separation minimum when utilizing surveillance (radar) was 5 Nm.

1.6.5 Fatigue Risk Management

ICAO classified fatigue as major human factors hazard since it affects the ability of crew member to perform his/her duty safely. Therefore, in the ICAO Annex 6 Part I subchapter 4.10.1 requires the State of the Operator to establish regulations for the purpose to manage fatigue. Therefore, the State of the Operator shall establish:

- regulations for flight time, flight duty period, duty period and rest period limitations; and
- where authorizing an operator to use a Fatigue Risk Management System (FRMS) to manage fatigue, FRMS regulations.

ICAO document 9966 describes a Fatigue Risk Management System (FRMS) as:

A data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness.

The document described the aims of FRMS is to ensure that flight and cabin crew members are sufficiently alert so they can operate to a satisfactory level of performance. The FRMS is relying on the concept of an effective safety reporting culture.

The detail guidance requirements for an FRMS are in Appendix 7 of the ICAO Annex 6 Part I and ICAO Document 9966.

In Indonesia, the regulation of fatigue management was described in the Civil Aviation Safety Regulation (CASR) Part 91 subchapter 91.515. The CASR requires each aircraft operator to establish and implement a fatigue management program that:

- ensures operations and maintenance staff are not fatigued when carrying out their duties;
- addresses flight and duty time limitations; and
- is included in the Operations Manual.

1.7 Additional Information

1.7.1 Human Performance

In the human brain, there is a clock which regulates 24-hour pattern of body function which controls the human sleep and wakefulness time¹¹. According to FAA aeromedical safety brochure¹², circadian rhythm is described as an internal biological clock that regulates our body functions, based on our wake/sleep. A circadian cycle disruption can lead to acute sleep deficits, cumulative sleep loss, decreases in performance and alertness, and various health problems.

Dinges et al (1996) explained that on 24-hour cycle, between 0200 and 0600 is estimation for window of circadian low, when human biological functions and performance efficiency are at their lowest level. Maintaining wakefulness or having sleep disturbance during the window of circadian low has a higher potential for fatigue and increased requirement for recovery.

The ICAO Document 9966 described fatigue as:

A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety-related duties.

The document also mentioned that the fatigue usually accompanied by feeling sleepiness and person was not aware that he/she was fatigue until make serious error. The cognitive or mental symptoms of fatigue can include short term memory problems, poor concentration and reduced ability to pay attention.

Human normally need 8 hours of sleep in a 24-hour period which losing as little as 2 hours of sleep will result in acute sleep loss, which will induce fatigue and degrade subsequent waking performance and alertness (Dinges et al, 1996)¹³.

In aviation, take-off and landing are the phases of flight with the highest workload and potential for accident, therefore, multiple take-offs and landings in a day might be expected to have cumulative effects on fatigue and human performance (Gander et al, 1998)¹⁴.

11 National Sleep Foundation, (2018). The article can be found in <https://sleepfoundation.org/sleep-topics/what-circadian-rhythm>

12 FAA (2009). *Circadian Rhythm Disruption and Flying*. The article can be found in <https://www.faa.gov/pilots/safety/pilotsafetybrochures/>

13 Dinges, David F., et al. (1996). *Principles and guidelines for duty and rest scheduling in commercial aviation*. The article can be found in <https://ntrs.nasa.gov/search.jsp?R=19990063635>

14 Gander et al (1998). Flight Crew Fatigue II: Short-Haul Fixed-Wing Air Transport Operations.

1.8 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 ANALYSIS

Refer to the available information there was no record or report of aircraft system and Air Traffic Services (controller) radar system malfunction. The investigation determined that the aircraft and controller radar serviceability were not issues in this occurrence. Therefore, the analysis will discuss the relevant issue as follows:

- Aircraft separation; and
- Pilot attention.

2.1 Aircraft Separation

At 1016 LT, prior holding on waypoint TIRUS, the controller instructed the LNI pilot to descend to altitude of 10,000 feet. One minute later when the controller radar display showed the LNI passed altitude of 10,300 feet, the controller instructed the BTK pilot to descend to altitude of 11,000 feet. This step descend clearance indicated that the controller was aware the possibility of conflict between the LNI and BTK since both aircraft were instructed to hold over the same waypoint. In addition, the altitude clearance issued by the controller was to separate both aircraft by 1,000 feet vertically.

At 1018 LT, the controller instructed the BTK pilot to descend to altitude of 11,000 feet and the BTK pilot read back the instruction correctly. About 10 seconds after received the clearance, the FDR recorded the target altitude selector on the FCU of the BTK was set from initially 11,000 feet to 10,000 feet. The BTK aircraft was continuing to descend to the altitude of 10,000 feet.

At 10:20:15 LT, the BTK passed altitude of 11,000 feet while the LNI was maintaining on altitude 10,000 feet. The vertical separation between two aircraft was decreasing to below 1,000 feet, while the horizontal separation was decreasing to below 4.4 Nm and then the Short-Term Conflict Alert (STCA) of the controller radar system for LNI and BTK activated with aural and visual alert. The separation between aircraft was below the requirement standard described in the AC 170-02 and the T-SOP of AirNav Indonesia branch office Surabaya.

At 10:20:24 LT, the LNI pilot confirmed to the controller whether any traffic above, followed by the controller instructed the BTK pilot to maintain altitude of 11,000 feet.

The STCA aural and visual alert did not trigger the controller to pay attention to the situation. This might be caused the vertical separation was still about 1,000 feet. The controller issued clearance to the BTK pilot when the LNI pilot confirming the traffic above. At 10:20:35 LT, when the LNI was still maintaining altitude of 10,000 feet, the LNI pilot received TCAS RA instruction “*DON'T CLIMB*”, while the BTK aircraft was continuing to descend. The vertical separation reduced to 400 feet while the horizontal reduced to 2.8 Nm. One second later, the BTK pilot received TCAS RA instruction “*DON'T DESCEND*”. The BTK pilot followed the TCAS RA and the aircraft maintained at altitude of 10,500 feet. At this time the vertical separation between aircraft was 400 feet while the horizontal was 2.7 Nm.

At 10:20:49 LT, the LNI descent and the separations increased and reached horizontal separation minima of 5 Nm at 10:22:04 LT.

The vertical separation reduced to below the requirement due to the target altitude of BTK aircraft was set to 10,000 feet, which made the BTK aircraft descending passed the assigned altitude of 11,000 feet. The separation regained after the activation of the TCAS RA warning which followed by the BTK pilot by maintaining aircraft altitude and the LNI pilot by descending the aircraft. The horizontal separation returned to the required standard after passed 5 Nm.

2.2 Pilot Attention

On 4 January 2018, two days prior the occurrence, the BTK pilots had overnight flight from Jakarta to Manokwari. The pilots signed on for duty at about 2200 LT and signed off at about 0640 LT the following day. The night duty during the window of circadian low might increase the potential of fatigue and required more time to recover.

On 5 January 2018, the pilots rested in a hotel in Manokwari. During the rest in Manokwari, there was no significant physical activity for the pilots. Both pilots did not recall the duration of sleep they took that day. On 6 January, the BTK pilots signed on the duty at 0605 LT and were scheduled for two flights with route Manokwari – Makassar – Surabaya. Considering the time for the pilot to prepare, having breakfast and transport from the hotel to the airport, the pilots might had woken up early. The Manokwari time was two hours earlier than Jakarta time and the pilot biological clock might still match with Jakarta time. Signed on at 0605 LT was considered an early morning schedule for the pilots.

All flights including the occurrence, the BTK PIC acted as PM and the BTK SIC acted as PF. The PM mentioned that his family medical issue was still in mind, especially when not many activities to be done.

The PF stated that during the occurrence flight he felt sleepy that might be caused by the overnight flight which increasing of potential fatigue and not fully recovered. The condition of the pilots woke up in early morning might reduce the time for recovery sleep.

The BTK pilots noticed that there was LNI below, however did not pay attention of its altitude. The PM was aware that the aircraft was under radar surveillance control and believed that all aircraft would be controlled and separated by the controller. The condition of relying on the controller reduced the PM awareness to monitor the other traffic communication and made the altitude clearance for LNI was not monitored.

During the descent, the cockpit condition was not busy as the flight was on direct flight to make holding over waypoint TIRUS and using autopilot. At 1018 LT, the BTK pilot was instructed to descend to altitude of 11,000 feet when the aircraft was on descend passing altitude of 13,200 feet. The previous communication made by the BTK pilot was at 1011 LT. Less activity in the cockpit within seven minutes might have made the PF felt sleepy and as for the PM this period of time reminded him to the family medical issue. These conditions reduced both pilots awareness.

The PM readback to the controller the descend clearance was to altitude of 11,000 feet, however, the advised to the PF of the clearance was to descend to altitude 10,000 feet. After clear of conflict, the PM was sure that the readback was to descend to altitude of 10,000 feet and asked why the controller did not correct the read back if it was wrong.

The cognitive or mental symptoms of fatigue can include short term memory problems, poor concentration and reduced ability to pay attention.

The slip of altitude clearance between the pilot mind and the readback was indication of decreasing human performance which most likely due to fatigue.

The PF did not make correction when the PM stated incorrect assigned altitude and set the target altitude selector on the Flight Control Unit (FCU) of 10,000 feet. This might be caused that the PF also did not listen the correct assigned altitude as the communication to the controller was not the main task of PF. The decrement of ability to pay attention was a cognitive symptom of fatigue.

The unrecovered fatigue and family issue reduced the pilot awareness during less cockpit activity, resulted in misunderstanding of assigned altitude and reduced the ability to monitor other traffic.

3 CONCLUSIONS

3.1 Findings¹⁵

1. The BTK and LNI aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). No report or record of aircraft system malfunctions on BTK and LNI aircraft prior to the occurrence.
2. The pilots of BTK and LNI held valid licenses, ICAO language proficiency and medical certificates.
3. The controller held valid licenses, rating, medical certificates and ICAO language proficiency.
4. The BTK PIC is Malaysian and stayed in Jakarta, while his family was in Malaysia. About one week prior the occurrence, the PIC took annual leave and back to Malaysia to resolve family medical issue.
5. Two days prior the occurrence, the BTK pilot had overnight flight from Jakarta to Manokwari. The night duty during the window of circadian low might increase the potential of fatigue and required more time to recover.
6. There was no significant physical activity during the rest period in Manokwari. Both pilots did not recall the duration of sleep they took that day.
7. The duty and rest period for the BTK pilot was meet the requirement of the Batik Air OM-A.
8. At the day of occurrence, the BTK pilots signed on at 0605 LT for two flight routes. It was considered an early morning schedule for the pilots and might reduce the time for recovery sleep.
9. All flights including the occurrence, the BTK PIC acted as PM and the SIC acted as PF. The PF stated that during the occurrence flight he felt sleepy and the PM mentioned that his family medical issue was still in mind, especially when not many activities to be done.
10. During the descent, the cockpit condition was not busy as the flight was on direct flight to make holding over waypoint TIRUS and was using autopilot.
11. The BTK and LNI pilots were instructed to make holding over waypoint TIRUS.
12. The BTK pilots noticed that there was LNI below, however did not pay attention of its altitude.
13. The controller was aware the possibilities of conflict between the LNI and BTK since both aircraft were instructed to hold over the same waypoint. The altitude clearance issued by the controller was to separate both aircraft by 1,000 feet vertically.

¹⁵ 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.

14. The controller instructed the LNI pilot to descend to altitude of 10,000 feet. One minute later, the controller instructed the BTK pilot to descend to altitude of 11,000 feet.
15. The BTK PM readback to the controller the descend clearance was to altitude of 11,000 feet, however, the advised to the PF of the clearance was to descend to altitude 10,000 feet.
16. The slip of altitude clearance between the pilot mind and the readback was indication of decreasing human performance which most likely due to fatigue.
17. The unrecovered fatigue and family issue reduced the pilot awareness during less cockpit activity, resulted in misunderstanding of assigned altitude and reduced the ability to monitor other traffic.
18. The STCA of the controller radar system activated with aural and visual alert for BTK and LNI when the BTK passed altitude of 11,000 feet. The STCA aural and visual alert did not trigger the controller to pay attention to the situation. This might be caused the vertical separation was still about 1,000 feet.
19. At 10:20:15 LT, the BTK passed altitude of 11,000 feet while the LNI was maintaining on altitude 10,000 feet. At this time, the separation between aircraft was below the requirement standard described in the AC 170-02 and T-SOP of AirNav Indonesia branch office Surabaya.
20. The closest distance of both aircraft laterally was about 1.9 Nm and vertically was about 600 feet at 10:20:57 LT.
21. The separation regained after the activation of the TCAS RA warning which followed by the BTK pilot and the LNI pilot descended the aircraft. The horizontal separation returned to the required standard after passed 5 Nm.
22. The vertical separation reduced to below the requirement due to the target altitude of BTK aircraft was set to 10,000 feet, which made the BTK aircraft passed the assigned altitude of 11,000 feet.

3.2 Contributing Factors¹⁶

- The vertical separation reduced to below the requirement due to the target altitude of BTK aircraft was set to 10,000 feet, which made the aircraft passed the assigned altitude.
- The unrecovered fatigue and family issue reduced the pilot awareness during less cockpit activity, resulted in reduced the ability to monitor other traffic and misunderstanding of assigned altitude.

¹⁶ Contributing factors is defined as events that might cause the occurrence. In the case that the event did not occur then the accident might not happen or result in a less severe occurrence.

4 SAFETY ACTION

After the occurrence, the Batik Air issued safety reminder to the BTK pilot to pay attention and maintain situational awareness to other traffic, and if the pilot had any doubtful according to the Air Traffic Controller clearance, the pilot should make confirmation to the air traffic controller.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledged the safety actions taken by the Batik Air, however, there still remain safety issues that need to be considered. Therefore, the KNKT issues the following safety recommendations addressed to the Batik Air and the Directorate General of Civil Aviation.

5.1 Batik Air

- **04.O-2018-01.1**

The duty and flight hour of both pilots did not exceed the requirement of the OM – Part A however, the slip of altitude clearance between the pilot mind and the readback, the ability to monitor the other traffic communication and feeling sleepy were indications of pilot fatigue. The fatigue might be caused by overnight flight which increasing of potential fatigue was not fully recovered, and the condition of the pilots woke up in early morning might reduce the time for recovery sleep.

Therefore, KNKT recommends the Batik Air to establish fatigue risk management which may refer to ICAO Annex 6 and ICAO Document 9966.

5.2 Directorate General of Civil Aviation

- **04.R-2018-01.2**

The Indonesia regulation of fatigue management is described in the Civil Aviation Safety Regulation (CASR) Part 91. However, the regulation did not contain detail guideline to establish fatigue risk management.

Therefore, KNKT recommends the DGCA to review the regulation for fatigue risk management.

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