AI2018-1

AIRCRAFT SERIOUS INCIDENT

INVESTIGATION REPORT

PEACH AVIATION CO., LTD.

J A 8 1 1 P

February 22, 2018

JTSB Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board (and with Annex 13 to the Convention on International Civil Aviation) is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT

PEACH AVIATION CO., LTD.
AIRBUS A320-214, JA811P
ATTEMPTED LANDING ON A CLOSED RUNWAY
ABOUT 5 NM EAST OF TOKYO INTERNATIONAL AIRPORT
AROUND 480FT AT 00:39 JST, DECEMBER 22, 2016

January 12, 2018
Adopted by the Japan Transport Safety Board
Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Yuichi Marui
Member Keiji Tanaka
Member Miwa Nakanishi

SYNOPSIS

<Summary of the Serious Incident>

On Thursday, December 22, 2016, an Airbus A320-214, registered JA811P, operated by Peach Aviation Co., Ltd, as the scheduled Flight 1028 of the company, while approaching runway 16L of Tokyo International Airport, mistakenly tried to approach for runway 23 which was closed at 00:39 JST. An air traffic controller in the control tower noticed the situation and instructed it to go around at the position of about 5 nm east of the airport. Afterward, the aircraft landed on runway 16L at 00:55 JST via visual approach following radar-vectored.

There were 164 persons on board consisting of the captain, five other crewmembers and 158 passengers. Nobody was injured and there was no damage to the aircraft.

<Probable Cause>

It is probable that the serious incident occurred because aircraft, conducting VOR-A approach to land on runway 16L of Tokyo International Airport, mistakenly tried to approach for runway 23 which was closed.

It is probable that the aircraft mistakenly tried to approach for runway 23 which was closed because advance preparations for VOR A approach by the captain and the first officer were not sufficient, and they could not recognize the runway change instruction to land as a threat and then they failed to manage workloads, properly monitor and advise.

Abbreviations used in this report are as follows:

AC	: Advisory Circular
AGL	: Approach Guidance Light
AQP	: Advanced Qualification Programs
AIP	: Aeronautical Information Publication
ALB	: Approach Light Beacon
ALS	: Approach Light System
ALT	: Altitude
AP	: Auto Pilot
APP	: Approach
ATC	: Air Traffic Control
ATIS	: Automatic Terminal Information Service
CG	: Center of Gravity
CGL	: Circling Guidance Light
CRM	: Crew Resource Management
CVR	: Cockpit Voice Recorder
DME	: Distance Measuring Equipment
FAA	: Federal Aviation Administration
FCOM	: Flight Crew Operating Manual
FCOM P	: Flight Crew Operating Manual Primary
FCTM	: Flight Crew Training Manual
FCU	: Flight Control Unit
FD	: Flight Director
FDR	: Flight Data Recorder
FGSC	: Flight and Ground Operation Sub Committee
FMGC	: Flight Management Guidance Computer
FPA	: Flight Path Angle
FPV	: Flight Path Vector
Fpm	: feet per minute
HDG	: Heading
IAF	: Initial Approach Fix
ICAO	: International Civil Aviation Organization
IFR	: Instrument Flight Rules
ILS	: Instrument Landing System
MAC	: Mean Aerodynamic Chord
MCDU	: Multipurpose Control Display Unit

MDA	: Minimum Descent Altitude
MOC	: Maintenance Operation Controller
MOD	: Manager on Duty
NAAP	: Noise Abatement Approach Procedure
NOTAM	: Notice To Airmen
ND	: Navigation Display
OCC	: Operation Control Center
OM	: Operations Manual
PF	: Pilot Flying
PFD	: Primary Flight Display
PM	: Pilot Monitoring
PTRT	: Pre Type Rating Training
QAR	: Quick Access Recorder
RWY	: Runway
TRK	: Track
SOP	: Standard Operating Procedure
TEM	: Threat and Error Management
VOR	: VHF Omnidirectional Radio Range
VS	: Vertical Speed

Unit Conversion Table

1 ft	: 0.3048 m
1 kt	: 1.852 km/h（0.5144 m/s）
1 nm	: 1,852 m
1 lb	: 0.4536 kg
1 atmospheric pressure	: 1,013 hPa (29.92 inHg)

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ATTACHMENT

1. PROCESS AND PROGRESS OF INVESTIGATION

1.1 Summary of the Serious Incident

On Thursday, on December 22, 2016, an Airbus A320-214, registered JA811P, operated by Peach Aviation Co., Ltd, as the scheduled Flight 1028 of the company, while approaching runway 16L of Tokyo International Airport, mistakenly tried to approach for runway 23 which was closed at 00:39. An air traffic controller in the control tower noticed the situation and instructed it to go around at the position of about 5 nm east of the airport. Afterward, the aircraft landed on runway 16L at 00:55 Japan Standard Time (JST: UTC+9 hr) via visual approach following radar-vectored.

There were 164 persons on board consisting of the captain, five other crewmembers and 158 passengers. Nobody was injured and there was no damage to the aircraft.

1.2 Outline of the Serious Incident Investigation

The occurrence covered by this report falls under the category of " Attempted Landing on a closed runway" as stipulated in Clause 2, Article 166-4 of the Ordinance for Enforcement of the Civil Aeronautics Act, and was classified as a serious incident.

1.2.1 Investigation Organization

On December 22, 2016, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and two other investigators to investigate this serious incident.

1.2.2 Representatives of the Relevant State

An accredited representative and advisers from France, as the State of Design and Manufacture of the aircraft involved in this serious incident, participated in the investigation.

1.2.3 Implementation of the Investigation

December 22 and 23, 2016	Interviews and aircraft examination
December 26, 2016	Verification of the radar track and air traffic control (hereinafter referred to as "ATC") communications records, and interviews
February 7, 8 and 16, 2017	Interviews

1.2.4 Comments from the Parties Relevant to the Cause of the Serious Incident

Comments were invited from parties relevant to the cause of the serious incident.

1.2.5 Comments from the Relevant State

Comments on the draft report will be invited from the relevant state.

2. FACTUAL INFORMATION

2.1 History of the Flight

An Airbus A320-214, registered JA811P (hereinafter referred to as "the Aircraft"), operated by Peach Aviation Co., Ltd (hereinafter referred to as "the Company") as the scheduled Flight 1028 of the Company, flew for Tokyo International Airport (hereinafter referred to as "the Airport" or "HND") from Taiwan Taoyuan International Airport (hereinafter referred to as "TPE") and conducted VOR A approach[1].

The flight plan of the Aircraft was outlined below:

Flight rules	: Instrument flight rules (IFR)
Departure aerodrome	: TPE
Estimated off-block time	: 21:45
Cruising speed	: 460 kt
Cruising altitude	: FL[2] 350
Destination aerodrome	: HND
Total estimated elapsed time	: 2 hr and 33 min
Fuel load expressed in endurance	: 4 hr and 47 min
Alternate airport	: Kansai International Airport (hereinafter referred to as "KIX")

When the serious incident occurred, the captain (hereinafter referred to as "the Captain") took the left seat in the cockpit of the Aircraft as the PF[3], and the first officer (hereinafter referred to as "the FO") took the right seat as the PM.

According to the records of the flight data recorder (hereinafter referred to as "FDR") and ATC communication records, as well as the statements of the flight crew members and the air traffic controllers (hereinafter referred to as "the Controllers"), the history of the flight up to occurrence of the serious incident is summarized as below.

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[1] Refer to 2.8.3 and Appended Figure 7 for VOR A approach.

[2] "FL" stands for flight level and is pressure altitude of the standard atmosphere. It is the altitude indicated by value divided by 100 of the index of the altitude indicator (unit: ft) when QNH is set to 29.92 inHg. FL is usually applied when flight altitude is 14,000 ft or above in Japan. E.g., FL 350 indicates an altitude of 35,000 ft.

[3] PF (Pilot-Flying) and PM (Pilot-Monitoring) are the terms to identify pilots on the basis of role sharing when operating aircraft by two pilots: The PF is mainly in charge of aircraft control and the PM is mainly in charge of monitoring the flight status, cross-checking of PF's operations and performing tasks other than flying.

2.1.1 History of the Flight based on Records of FDR and ATC Communications

Bracket [ ] in the section corresponds with [A] to [I] in the Appended Figure 5 "FDR Records" of the closing section.

On December 22, 2016

00:23:48 The Aircraft had an initial contact with the approach controller at Tokyo Radar Approach Control Facility[4] (hereinafter referred to as "Tokyo Approach") with information "B" of ATIS code[5].

00:24:01 Tokyo Approach reported that the Aircraft would be set to land on runway 34R via ILS Y approach[6] procedure.

00:26:26 Tokyo Approach reported that he expected to change landing runway to runway 16L via VOR A approach procedure, and it read back.

00:28:42 Tokyo Approach instructed the Aircraft to fly via DARKS arrival, and it read back.

00:30:23 Tokyo Approach cleared it to conduct VOR A approach via DARKS arrival[7] , and it read back.

00:31:27 The Aircraft passed KAIHO[8].

00:35:55 Landing gear lever was operated to the down position.

00:35:57 The Aircraft was transferred to the aerodrome controller at Tokyo Airport Traffic Control Tower[9] (hereinafter referred to as "Tokyo Tower").

00:36:17 Horizontal mode of autopilot (hereinafter referred to as "AP") was set to "HDG[10]." 〔A〕

00:36:24 The Aircraft reported to Tokyo Tower passing DARKS.

00:36:30 Tokyo Tower reported wind direction of 320 degree and wind speed of 2 kt, and instructed to continue approaching for runway 16L.

00:36:38 Vertical speed (VS) was set to -1,000 fpm following being set "VS[11]" in vertical mode of AP. 〔B〕

00:37:22 VS was set to -700 fpm.

00:37:34 Flaps position of the Aircraft was set to Flaps 3.

00:37:38 Flaps position of the Aircraft was set to Flaps full.

00:38:06 The Aircraft passed over MDA, 〔C〕 and VS was set to 0 fpm. 〔D〕

00:38:29 AP was disengaged. 〔E〕

00:38:30 The Aircraft started to turn left. 〔F〕

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[4] Radar Approach Control Facility is a facility which works for terminal radar approach control and approach control.

[5] ATIS is an information on such as types of approach, runways to use, airport conditions and weather condition, broadcasting to aircraft engaging with takeoff and landing. Refer to 2.6.2 for the contents of Information "B" of ATIS code.

[6] There are two ILS approach procedures for runway 34R of "ILS Y"and "ILS Z," different in approach course and missed approach course and others. In addition, information "B" broadcasted that ILS Y approach was in progress. (Refer to 2.6.2)

[7] DARKS is a waypoint name and DARKS arrival stands for arrival route connected it. (Refer to Appendix Figure 6 and 7)

[8] Refer to Appended Figure 1 and 6 for KAIHO.

[9] Airport Traffic Control Tower is a facility which works for airport traffic control.

[10] Aircraft is controlled by heading in HDG mode.

[11] Aircraft is controlled by vertical speed in VS mode.

00:38:36 Flight Director (hereinafter referred to as "FD") was disconnected.

00:38:49 Tokyo Tower reported that it was expected that another trafiic would depart and instructed to continue approach, and it read back.

00:39:07 HDG (TRK) [12]was set to 157degree. 〔G〕

00:39:14 TRK/FPA[13] was selected. 〔H〕

00:39:18 Tokyo Tower repeatedly instructed the Aircraft to turn right immediately.

00:39:29 Tokyo Tower instructed it to turn right 330 degree and climb to 3,000 ft and it read back.

00:39:37 Altitude of the Aircraft indicated the lowest value of 480ft on the record. 〔I〕

00:40:23 Radar-guidance was started to providing to the climbing Aircraft.

00:50:28 The Aircraft was cleared for visual approach[14] following the precedent aircraft.

00:54:50 The Aircraft landed on runway 16L.

2.1.2 Statements of Parties relevant to the Serious Incident

(1) The Captain

The Captain reported to the Company office in KIX at 16:30 the day before the serious incident. The FO and he were supposed to fly two sectors: KIX/TPE and TPE/HND on that day.

During cruise for HND from TPE, the Captain gave an approach briefing for ILS Y approach runway 34R following checking ATIS and NOTAM, after completing it the Aircraft started to descend. Tokyo Approach initially reported that it would be supposed to land on runway 34R via ILS Y approach. However, when the Aircraft was flying around position of 1~2 minutes to KAIHO, Tokyo Approach reported that he was expecting that landing runway would be changed and the Aircraft would land on runway 16L via VOR A approach. The Captain was amazed because he did not expect any possibilities of landing runway change at all and he had no idea about the reason for this change,but he thought that he could manage to address this situation because it was a good weather around the Airport. He asked the FO to set up MCDU[15] but later he noticed that the FO looked confused.

He verified DARKS arrival[16] on MCDU and recognized that VOR A approach was not registered in navigation data base[17] in FMGC[18] (hereinafter referred to as "Database"). While flying he gave approach briefing for VOR A approach referring to approach chart of VOR A approach and he verified VOR/DME of HND (HME) in the line of VOR selection, however, he could not have enough time to refer to the chart of preferential route for noise abatement[19].

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[12] Refer to 2.9. for HDG (TRK).
[13] TRK and FPA stand for track and flight path angle respectively.
[14] Visual approach is one of approaches, performed by IFR aircraft controlled by ATC facilities, in which a pilot would fly seeing visual references without following prescribed approach procedures.
[15] MCDU stands for Multipurpose Control Display Unit to refer to and input the desired data in FMGC. (refer to 2.9.1.)
[16] Refer to Appended Figure 6 "DARKS arrival"
[17] Navigation data base means navigation data registered and stored in FMGC.
[18] FMGC stands for Flight Management Guidance Computer.
[19] Aircraft intending to land on runway 16L is required to follow operational procedures for noise abatement prescribed in AIP. (refer to 2.8.4)

When passing DARKS, the Captain saw many lights such as lightings in the Airport, city lights and lights around industrial areas and the Aircraft started to descend horizontally in HDG mode and vertically in VS mode with VS-1,000 fpm, but he did not yet identify runway 16L. He had no memory of passing altitude of SAZAN[20] and automatic callout[21] for MDA[22] but he had intended to try to maintain MDA. While tasks around him such as challenging checklist might be hectic, he still could not find runway 16L.

Under these circumstances, the Captain instinctively let the Aircraft turn left because he saw the runway which looked bright in left front of him, and he ordered the FO to set the HDG/TRK selector to 157 degree of runway 16L track and set TRK/FPA. Shortly after this setting, he realized that there was something wrong because he could not see HDG (TRK) bug on PFD[23] and noticed that magnetic heading indicated 230 degree. Lots of concerns came up to his mind : he wondered if the runway in front of him might not be runway 16L but runway 23 which was closed, a closed runway must be in complete darkness, he must execute a missed approach and let the Aircraft turn left. Just at that moment, he was instructed from Tokyo Tower that he should climb and turn right immediately. The Captain was first confused about the instruction Tokyo Tower ordered because he was instructed an opposite direction from the one prescribed in the missed approach procedure. However, he received another specified instruction on direction and altitude and followed it. Afterward, it was provided with radar-guidance and landed on runway 16L via visual approach.

After finishing flight duies, the Captain and the FO discussed the event at a hotel. The Captain filed Air Safety Report[24] to the Company that he was late to start turning to downwind for circling to runway 16L and just at the moment when he intended to interrupt the approach, he had been instructed to execute a missed approach.

Altough the Captain had a decade flight experience on Airbus A320 (hereinafter referred to as "the Type") and many opportunities to land on runway 16L in the Airportin tha past, he experienced VOR A approach followed by circling approach[25] to runway 16L for the first time on that day. When the Captain looked back this serious incident, he should have reported to the Controller that he had been short on time for preparations, and he should have requested a holding or a radar guidance for a visual approach.

(2) The FO

The FO had ever about two decades flight experience and started to learn jetliner's piloting first after joining the Company. He began his career as a first officer of the Type four months before when

[20] Refer to Appended Figure 1 , 2 and 7 for SAZAN.
[21] Automatic callout is one of synthetic voice generated in aircraft. "ONE HUNDRED ABOVE" and "MINIMUM" are announced at the altitude of 100 ft before approach height threshold (AHT) and at AHT respectively.
[22] MDA stands for Minimum Descent Altitude for non-precision approach.
[23] Refer to 2.9.2 for PFD and HDG (TRK) bug.
[24] Air safety Report (ASR) is a report upon request by the Company, which is different from captain report based on Civil Aviation Act.
[25] Circling approach is an approach flying around the runway by visulal flying manner after identifying the airport or the runway .

the serious incident occurred. He had ever flown about 400 hours on the Type but this is his second time to make an approach for the Airport and his first time to conduct the circling approach following VOR A approach.

The Aircraft was reported the landing runway change from Tokyo approach prior to KAIHO. The FO could enter MDA and select DARKS arrival, however, he failed to find VOR A approach in Database and it took quite a long time for him to process. In addition, he entered "RWY 16L" as landing runway[26] and he checked that a symbol of runway was appeared on ND. The Captain gave another briefing for VOR A approach, however, he did not refer to specific procedures such as turning right to downwind after identifying the runway. He thought that it was because they did not have enough time to spare. After Passing DARKS, he could see the Airport right in front of him and he remembered seeing ALB[27] which was a reference for approach for runway 16L brightly illuminating, however, he could not identify the runway. He tried to crosscheck outside, the approach chart and indication on ND during approach but he was mostly centering on operational processes such as setting of flaps. Therefore, he could not monitor the flying course properly and he did not remember well about altitude the Aircraft passed over.

When the FO noticed that the Aircraft was turning left and saw outside, he realized that there was a brightly lighted runway in left front of him. Then he set runway track of runway 16L following the Captain's order. He had his own image of flying course: the Aircraft should turn right first to enter the downwind and then turn left in the base leg to align. Therefore, he felt odd when he perceived that the Aircraft aligned to runway 16L without flying along such a route as he imagined. However, the FO relied on the Captain and he interpreted that the Aircraft flew to the point where runway was just in front of him before he noticed. He thought that it is because he could not monitor properly. Therefore he did not try to confirm his odd feeling with the Captain. He was uncertain to hear auto callout for MDA.

The FO remembered that they were instructed to turn right immediately from Tokyo Tower when they completed landing checklist, and at the next moment when he was going to ask the reason why they should turn right there, they received another specific instruction of climbing and turning right from Tokyo Tower and followed it.

The FO gave a report to the dispatcher[28] and the manager of the flight crew deaprtmament that they mistakenly approached for runway 23 (hereinafter refer to as "the First Report") right after disembarking from the Aircraft. They arrived at the hotel and discussed the event. He listened to the Captain's story that they were instructed to go-around just at the moment when the Captain was going to do so because the Captain could not find runway 16L, and he realized his error in the First

[26] When enterting "landing runway" in MCDU, two parallel lines indicating runway, magnetic course line connecting with runway threshold (RTHL) and "CF" indicating a point of 5 nm from RTHL appear in ND. (refer to Figure 8 in 3.4.1)
[27] ALB stands for Approach Light Beacon, which is a flashing white light.
[28] The dispatcher described herein stands for "MOD-Dispatcher" in 2.13.1

Report and gave a report that included the amended content.(hereinafter refer to as "the Second Report").

(3) The Controllers in Tokyo Radar Approach Control Facility

Around 24:00 when Tokyo Approach took his controller's seat, runway 16L was used for departures and runway 34R was used for arrivals.

Tokyo Approach initially reported to the Aircraft that it was supposed to land on runway 34R via ILS Y approach, then he realized that Tokyo Radar Approach Control Facility had arranged how to operate landing runway with Tokyo Airport Traffic Control Tower and they decided to change the operation for landing runway to runway 16L. He watched the radar scope and speculated about which aircraft should be applied to the first landing on runway 16L, then he decided the Aircraft which was flying around 10,000 ft should be the one and notified it that landing runway would be changed and it would be expected to land on runway 16L via VOR A approach. As he received a prompt readback from the Aircraft's pilot, he thought that there would not be any problems and afterward he gave it a clearance for VOR A approach.

Tokyo Approach also instructed to succeeding aircraft of the Aircraft to follow VOR A approach. However, a pilot reported that the company rules prohibited to conduct VOR A approach and other pilot reported not to be allowed to conduct either VOR A approach or visual approach. Therefore, he instructed them to conduct visual approach for runway 16L, or ILS Y approach for runway 34R after a holding respectively.

In Tokyo Radar Approach Control Facility, at the briefing before starting work on the day, the Controllers were expecting that runway C[29] became the only runway to be operational after runway D[30] was closed due to scheduled maintenance and arrival aircraft would conduct VOR A approach if traffic flows were growing.

The Controllers in Tokyo Radar Approach Control Facility do not explain the reason why runway change is generated in normal operations when they instruct runway change. Tokyo Approach, at this occasion, did not notify the reason of runway change in the same manner. Regarding the timing of notification of runway change for arrival aircraft, he recognized that the earliest possible timing would be preferable for pilots, while no specific standards are laid down. Moreover, he thought that if the Aircraft's pilot requested ILS approach at that time, he was willing to accept it.

(4) The Controllers in Tokyo Airport Traffic Control Tower

Around 23:00 (JST) when Tokyo Tower took his controller's seat, "north wind operation[31]" was in progress. As a result of arrangement with Tokyo Radar Approach Control Facility, Tokyo Airport

[29] Refer to 2.8.1 for runway C.
[30] Refer to 2.8.1 for runway D.
[31] Refer to 2.8.4 for "north wind operation" and "south wind operation".

Traffic Control Tower decided to apply "sounth wind operation," in which the Aircraft and the subsequent arrival aircraft should conduct VOR A approach. This is because the Controllers required to handle air traffic flows effectively when departure aircraft were increasing after runway D became closed.

Tokyo Tower received an initial contact from the Aircraft flying for DARKS and instructed to continue approach for runway 16L. He intended to make two aircraft depart prior to landing of the Aircraft. He gave a takeoff clearance to the first one and a "lineup and wait" instruction to the second. Then he reported that there was one departure traffic on the runway and instructed that the Aircraft should continue an approach. Later, the Aircraft looked like flying a little lower and not turning right for the downwind of runway 16L but turning left, then he felt that it flew strangely and something was wrong with it. Afterward, since it looked continuously turning left toward runway 23 and he should maintain separation between the departure aircraft from runway 16L and the Aircraft, he instructed it to turn right and climb for go-around. He received a readback in a moment but it did not look starting right turn, therefore, he gave a specific instruction: turning 330 degrees and climbing and maintaining 3,000 ft.

Since Tokyo Tower had ever seen the event in which arrival traffic conducting VOR A approach went wrong and ended up to go-around, he had carefully watched the movement of the incoming traffic at that time. He had no concern with the status of each lighting system on runway D because he had already handed over the authority to operate aerodrome lightings to electrical engineer in charge of aeronautical lights[32] (hereinafter refer to as"the Enginer for lights") but he remembered that the runway 23 looked brighter than in usual operation at that time, it might be because there were lots of working vehicles there. Regarding operations of lights such as Sequenced Flashing Lights(SFL) and Approach Light System(ALS), those lightings were turned off because they were observing the agreements [33]among those relevant parties in which preventative measures against mistaken approaches for closed runway were described.

When Tokyo Tower looked back this event, he thought that he should have instructed such as "report right break," "report downwind," because those might be beneficial and became reminders for pilots.

In Tokyo Airport Traffic Control Tower, the Controllers thought that VOR A approach was difficult to control because it allowed aircraft to fly in high degree of freedom and it was also hard for them to adjust timings when they could gave a departure clearance to take off. They have properly shared information preparing for VOR A approach being in progress, that they should watch for arrival aircraft carefully and give an immediate instruction if it looked strange to fly and they have been instructed to carefully observe traffics, especially for foreign airliners.

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[32] "Electrical engineer in charge of aeronautical lights" is an officer who works for construction, operation and maintenance of aeronautical lights and other electrical facilities in airports.

[33] Refer to 2.8.6 for the agreements among those relevant parties.

In this serious incident, Tokyo Tower instructed to turn right immediately to the Aircraft at the position of approximately 5 nm east-northeast from the Airport (35° 34' 25" N, 139° 53' 14" E), at the time of 00:39:29 on December 22, 2016.
(See Appended Figure 1 "Estimated Flight Route_1," Appended Figure 2 "Estimated Flight Route_2," Appended Figure 3 "Estimated Flight Route_3")

2.2 Damage to Person

There was no injured person.

2.3 Damage to the Aircraft

There was no damage to the Aircraft.

2.4 Flight Crewmembers Information

(1) Captain Male, Age 62

Airline transport pilot certificate (Airplane)	March 8, 2006
Type rating for Airbus A320	March 8, 2006
Class 1 aviation medical certificate	
Validity	September 16, 2017
Total flight time	24,104 hr and 45 min
Flight time in the last 30 days	54 hr and 00 min
Total flight time on the type of aircraft	8,940 hr and 35 min
Flight time in the last 30 days	54 hr and 00 min

(2) First Officer Male, Age 45

Commercial pilot certificate (Airplane)	October 02, 1997
Type rating for Airbus A320	April 22, 2016
Instrument flight certificate	September 11, 2015
Class 1 aviation medical certificate	
Validity	July 08, 2017
Total flight time	3,530 hr and 37 min
Flight time in the last 30 days	76 hr and 07 min
Total flight time on the type of aircraft	405 hr and 01 min
Flight time in the last 30 days	76 hr and 07 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Airbus A320-214
Serial number	5874
Date of manufacture	December 06, 2013
Certificate of airworthiness	Dai-2015-356

Validity : Period starting from September 30, 2015 during which the maintenance manuals are applied;

Category of airworthiness	Airplane Transport T
Total flight time	8,836 hr 27 min
Flight time since the last periodic inspections	5 hr 41 min

(Maintenance before airworthiness certificate inspection conducted on December 21, 2016)

(See Appended Figure 10 "Three-View Drawing of Airbus 320-214")

2.5.2 Weight and Balance

When the serious incident occurred, the Aircraft's weight is estimated to have been 131,962 lb, and the position of the center of gravity is estimated to have been 32.0% mean aerodynamic chord (MAC[34]), both of which are estimated to have been within the allowable range (maximum landing weight of 142,198 lb and 20.4 – 37.8% MAC corresponding to the weight at the time of the incident).

2.6 Meteorological Information

2.6.1 TAF and METAR

(1) Aerodrome Forecast (TAF)

The aerodrome forecast (TAF) was issued by the Airport at 14:06 on a day before the occurrence of the serious incident was as follows;

From 06:00 on 21st to 12:00 on 22nd (UTC);

Wind direction 130°, Wind velocity 6 kt, Visibility 10 km or more

Cloud : Amount FEW, Cloud base 3,000 ft

Changes is forecasted during the time from 14:00 to 16:00 on 21st (UTC);

Wind direction 320°, Wind velocity 4 kt (The rest is omitted)

(2) Aviation Routine Weather Report (METAR)

Aviation Routine Weather Reports (METAR) of the Airport around the time of the occurrence of

[34] "MAC" stands for Mean Aerodynamic Chord, which is a blade chord representing aerodynamic characteristic of a blade. MAC is the typical chord length when they are not identical, such as those of a sweptwing. The value 32.0% MAC indicates the position at 32.0% from the leading edge of the aerodynamic average of blade chords.

the serious incident was as follows;

Table 1 Aviation Routine Weather Report (METAR)

Observation time (UTC)		14:00	15:00	15:30	16:00
Wind Direction		270	variable	240	240
Wind Velocity		3	1	3	3
Fluctuation Range of Wind		190 ~ 290	-	170 ~ 310	160 ~ 290
Visibility (m)		10 km or more	10 km or more	10 km or more	10 km or more
Current weather		-	-	-	-
Cloud	Amount Type Cloud base (ft)	1/8 Cumulus 3,000	1/8 Cumulus 3,000	1/8 Cumulus 3,000	1/8 Stratocumulus 3,000
	Amount Type Cloud base (ft)	3/8 Stratocumulus 4,500			3/8 Stratocumulus 4,000
Temperature (°C)		11	12	12	13
Dew point (°C)		7	8	8	8
Altimeter setting (QNH) (inHg)		30.37	30.35	30.33	30.32

(See Appended Figure 4 "Meteorological Information")

2.6.2 ATIS Information

ATIS information prior to the occurrence of the serious incident was as in Table 2, including approach procedures, runways for takeoff/landing, weather information and information of closed runway[35].

[35] Refer to 2.8.5 for "Runway closed information."

Table 2 ATIS Information

Transmission time (UTC)	14:31	15:01	15:28	15:30
Information	A	B	C	D
Approach procedure	ILS Y Runway 34R	ILS Y Runway 34R	VOR A	VOR A
Runway for landing	34R	34R	16L	16L
Runway for takeoff	16L	16L	16L	16L
Meteorological information	Same as METAR at 23:30	Same as METAR at 00:00	Same as METAR at 00:00	Same as METAR at 00:30
Closed runway	16R/34L 05/23	16R/34L 05/23	16R/34L 05/23	16R/34L 05/23

2.7 Flight Recorder Information

The Aircraft was equipped with an FDR, which had a maximum recording time of 25 hours, and an a cockpit voice recorder (hereinafter referred to as "CVR") which had a maximum recording time of two hours, both made by Honeywell of the United States of America.

The Aircraft continued the flight without removing FDR and CVR after the occurrence of the serious incident. FDR retained the data when the serious incident occurred, but CVR was not removed because it was clear that the data was overwritten.

The time data in FDR was calibrated by correcting the time signals in the ATC communication records with the VHF transmission keying signals in FDR.

2.8 Information on the Serious Incident Site

2.8.1 Outline of the Airport

The Airport was at an elevation of 21 ft, having four runways as shown in Figure 1.

These runways are occasionally called as runway A (16R/34L), runway B (04/22), runway C (16L/34R) and runway D (05/23) for the sake of convenience.

When the serious incident occurred, the runway which the Aircraft was instructed to land on was runway C (runway 16L), which is 3,360 m in length, 60 m in width and 157° in magnetic direction. And the closed runway which the Captain mistakenly tried to approach for was runway D (runway 23) which is 2,500 m in length, 60 m in width and 230° in magnetic direction.

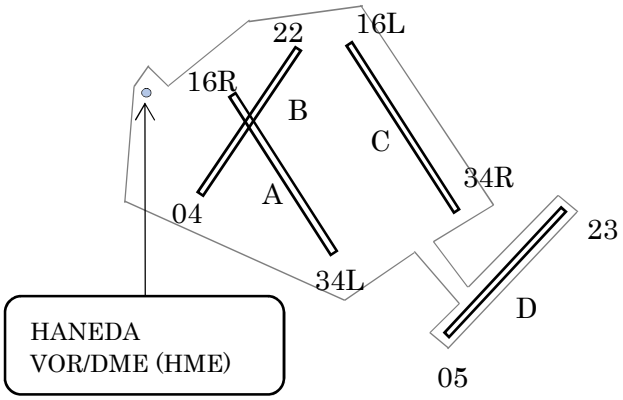

Figure 1 Runway at the Airport

2.8.2 Approach and landing information on runway C

The approach procedure for runway C in south wind operation is either VOR A approach procedure or visual approach.

The following aeronautical lights[36] are installed for circling approaches to runway 16L and 16R at the Airport. (See Figure 2.)

(1) Circling guidance lights (CGL)

Circling guidance lights are installed in order to indicate runway position for circling aircraft. Steady variable white lights are placed.

(2) Approach light beacon (ALB)

Approach light beacons are installed in order to indicate any significant point for approaching aircraft to land. Flashing white lights are placed.

(3) Approach guidance lights (AGL)

Approach guidance lights are installed in order to indicate a flight path for departing/arriving aircraft. Flashing white lights are placed.

(4) Landmark beacon (LBN)

A landmark beacon is installed in order to indicate a specific point for flying aircraft. Flashing white lights are placed.

In addition, in the approach chart used by the flight crew members in the Company, following description is listed; It is difficult to find out visual references due to the widespread city lights during the nighttime, while the installations of AGL and CGL are noted.

[36] "Aeronautical Lights"consists of "Aeronautical beacon", "Aerodrome lights" and "Obstacle lights."

2.8.3 Circling Approach to runway 16L via VOR A approach procedure

VOR A approach procedure at the Airport is shown in Appended Figure 7, which is connected from DARKS arrival in Appended Figure 6. Under normal conditions, after a pilot shall fly over DARKS at or above 1,800 ft he/she shall fly along 274° course for HME to fly over SAZAN at or above 1,100 ft. Then after identifying runway 16L visually, he/she shall turn right to enter circling approach: for downwind of runway 16L. As later described in 2.8.4, regarding conducting a circling approach "The preferential route for noise abatement[37]" were officially published, in which a pilot was requested to fly along or inside of the route in order to abate noise.

Furthermore, selection of altitude for circling approach is up to a pilot, while MDA of 760 ft for VOR A approach is prescribed.

2.8.4 Aircraft Operating Procedures for Noise Abatement at the Airport

AIP has following description about Aircraft Operating Procedures for Noise Abatement at the Airport;

1. Noise restrictions

Following noise abatement procedure on Tokyo International Airport are in force;

- *Noise Preferential Runways*
- *Preferential Routes and Aircraft Operating Procedures for Noise Abatement*
- *Noise Abatement Approach Procedure (NAAP)*

2. Noise Preferential Runways

Runways described below ar

(omitted)

[37]Refer to 2.8.4 for "The preferential route for noise abatement."

Table 3 Preferential Runway Procedure

(Takeoff)	
1400 ~ 2100 (UTC)	*1. RWY05 (north wind operation applied) or RWY16L (south wind operation applied) is preferentially used.*
	2. When RWY05 and RWY16L are not available, RWY16R is used.
	3. RWY34R is available only when north wind operation applied under following a. or b. circumstances, and RWY16L/R does not suit for safe takeoff. *a. RWY05 is closed;* *b. The wind condition on departure exceeds crosswind or tailwind takeoff limitations of RWY05.* *(the rest is omitted)*
	4. RWY04 is used when RWY05, RWY16L/16R and RWY34R are not available.
(Landing)	
1400 ~ 2100 (UTC)	*1. RWY34R (north wind operation applied) or RWY23 (south wind operation applied) is preferentially used.*
	2. When north wind operation applied, and RWY34R is not available, RWY34L is used.
	3. When south wind operation applied, and RWY23 is not available, RWY16L and RWY22 is used in this order.

Furthermore, operational configurations described in the Operation Procedures for the Air Traffic Control is as follows;

- "North wind operation" is one of operational configurations in which both runway 34L and runway 34R or either one of them are used for landing, and both runway 34L and runway 05 or either one of them are used for takeoff.
- "South wind operation" is one of operational configurations in which both runway 22 and runway 23 or either one of them are used for landing, and both runway 16L and runway 16R or either one of them are used for takeoff.

3. Preferential Routes and Aircraft Operating Procedures for Noise Abatement

Except in the event an aircraft is in an emergency, an unavoidable situation or unless otherwise specified by NOTAMs, the following procedures shall be adhered to by all aircraft. However, none of the procedures herein is intended, in any manner, to abrogate the responsibility of the pilot in command to assure the safe operations of the aircraft.

Table 4　Preferential Routes and Aircraft Operating Peocedure for Noise Abatement

(For Takeoff)

(omitted)

(For Landing)

1. In order to reduce aircraft noise in the residential area, gear-down should be delayed as far as operationally practicable.

(omitted)

2. Between the hours of 1300UTC and 2200UTC, aircraft should perform Delayed Flap Approach Procedure.

1400 ～2100 (UTC)	*RWY34R*	*「ILS Y or LOC Y RWY 34 R」(via KAIHO)*
		「VOR A」(via DARKS ARRIVAL)
	RWY16L	*In order to minimize public annoyance for aircraft noise in the residential areas located north of the airport, aircraft should fly along or inside of the course shown in attached chart during the circling to final.*

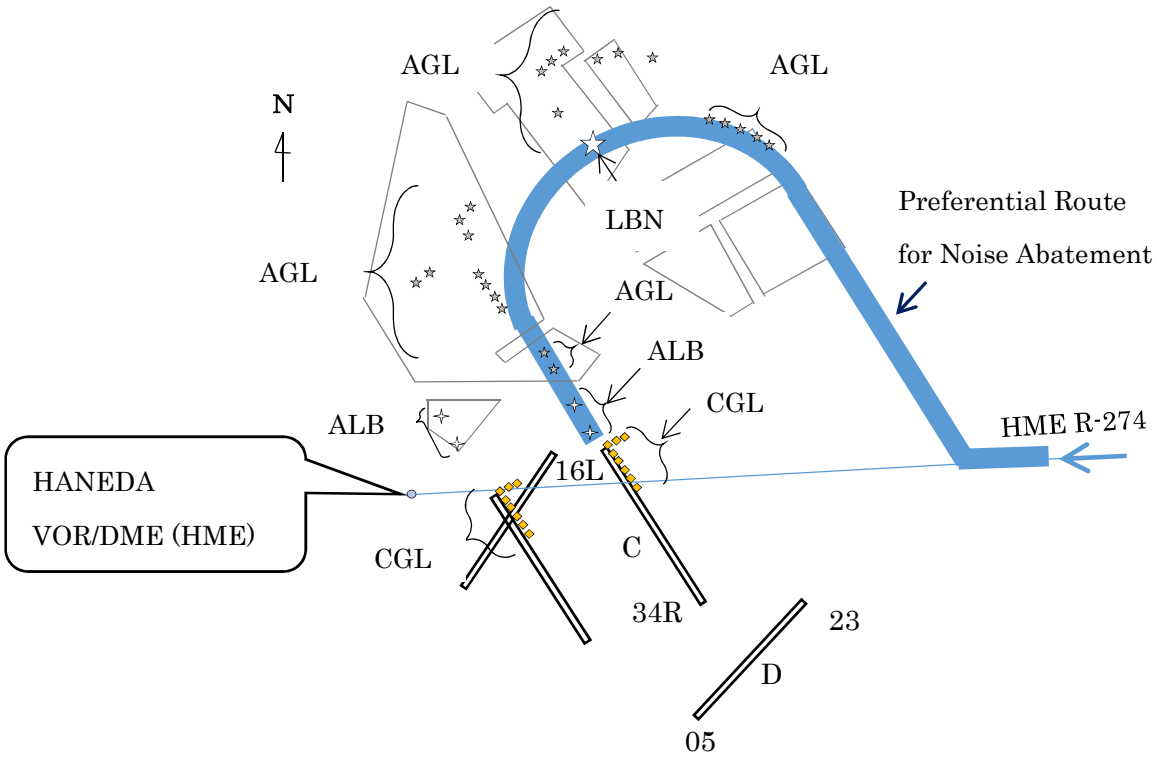

Figure 2　Preferential Route for Noise Abatement and the associated Aeronautical Lights

2.8.5 Information on the Airport relating to the Closed Runway

(1) AIP

AIP lists "schedule maintenance on the runway" at the Airport as shown Table 5, and it specifies referring to NOTAM RJTT for further detailed information.

Table 5 Schedule maintenance on the runway

FACILITY	*PLANNED PERIOD (UTC)*	*REMARKS*
RWY16R/34L	*MON,WED,THU,SAT* *14:30-21:00*	*AVBL CROSS RWY 16R/34L VIA TWY OTHER THAN CLSD TWY*
RWY04/22	*MON, TUE, THU, FRI, SUN* *14:30-21:00*	*AVBL CROSS RWY 04/22 VIA TWY OTHER THAN CLSD TWY*
RWY16L/34R	*TUE, FRI, SUN* *17:00-21:00*	
RWY05/23	*WED 14:30-21:00* *SAT 17:00-21:00*	

(2) NOTAM

Among NOTAMs relating to the Airport which were effective at the time of the serious incident occurrence, there is the following description on the closure of runway D in NOTAM No. 4263216 ;

- Schedule and duration to apply: From 14:30 to 21:00 (UTC) on December 22
- For maintenance purpose, runway 05/23 shall be closed

2.8.6 Information on Partial Light-out of Aeronautical Lights relating to Closed Runway

(1) The relevant parties[38] summarized "an agreement about partial light-out of aeronautical lights relating to closed runway at Tokyo International Airport" in order that they might secure safety of flights and field operations such as construction works; the following descriptions were included; (excerpts)

2. Air traffic controller shall turn off the following lights of closed runway.

Approach Light System(ALS), Sequenced Flashing Lights(SFL), Precision Approach Path Indicator (PAPI), Circling Guidance Lights(CGL), Approach Light Beacon(ALB), Approach Guidance Lights(AGL), Runway Touchdown Zone Lights(RTZL), Runway Threshold Identification Lights(RTHL), (omitted)

4. The Engineer for lights could turn on the lights shown in the preceding paragraph 2, only when it is required for works. However, when turning on ALS, SFL and PAPI, an advance consultation with air traffic controllers shall be required.

[38] The relevant parties herein mean air traffic controller, operationanl information officer, and the Engineer for lights.

(2) Based on the log data of aerodrome lighting aids provided from the Civil Aviation Bureau, situations of the aeronautical lights relating to runway D being closed when the serious incident occurred were as follows;

- Lights-out: SFL, ALS, RTZL, and PAPI
- Lighting as required: Runway Edge Lights, Runway Centerline Lights, RTHL, and Taxiway Edge Lights

2.8.7 Departure/Arrival Status around the time of the Occurrence of the Serious Incident

Departure/Arrival status around the time of the occurrence of the serious incident was as follows in Table 6.

Table 6 Departure/Arrival Status of aircrafts

Event	Event time (JST)	Aircraft	Approach Procedure	Runway for Landing	Runway for Takeoff
Arrival	0:32		ILS Y	34R	
Departure	0:35				16L
Departure	0:38				16L
Go-around	0:39	The Aircraft	VOR A		
Arrival	0:47	aircraft A**1	VOR A	16L	
Arrival	0:50	aircraft B**2	VOR A	16L	
Departure	0:50				16L
Arrival	0:52	aircraft C**3	Visual Approach	16L	
Arrival	0:53	The Aircraft	Visual Approach	16L	
Departure	0:57				16L
Departure	0:59				16L
Departure	1:02				16L
Departure	1:04				16L
Arrival	1:14	aircraft D**4	ILS Y	34R	

**1 Aircraft A requested a landing on runway 34R via ILS approach, but it was rejected because of increasing number of departing traffic from runway 16L. Afterwards, it landed on runway 16L via VOR A approach.
**2 According to the statement of pilots of aircraft B, the same company flight as the Aircraft, they were surprised at the sudden instruction of runway change, however, they accepted it since they had experienced VOR A approach in the past and expected that things would work out.
**3 Aircraft C reported that it was not possible for them to conduct VOR A approach because of their company rules and it landed on runway 16L via visual approach.
**4 Aircraft D reported that it was not possible for them to conduct VOR A approach or visual approach in the night time, and it requested ILS approach. It was instructed for a holding in the air, then it landed on runway 34R via ILS approach.

2.9 The Cockpit Outline of the Type

2.9.1 Outline of FCU and others

As shown in Figure 3, integrated instrument PFD & ND are placed in front of each pilot's seats. FCU in the glareshield incorporates HDG/TRK selector knob to set HDG/TRK and the respective window, ALT selector knob to set altitude and the respective window, VS/FPA selector knob to set vertical speed / flight path angle and the respective window, and HDG/VS - TRK/FPA select button (hereinafter referred to as "Select Button"). When pressing Select Button in the state of "HDG/VS" indication, indication in relevant windows are changed to "TRK/FPA[39]" indictaion and displays FPV (hereinafter referred to as "Bird").

In addition, each pilot have MCDUs at hand, which are used for data input and others.

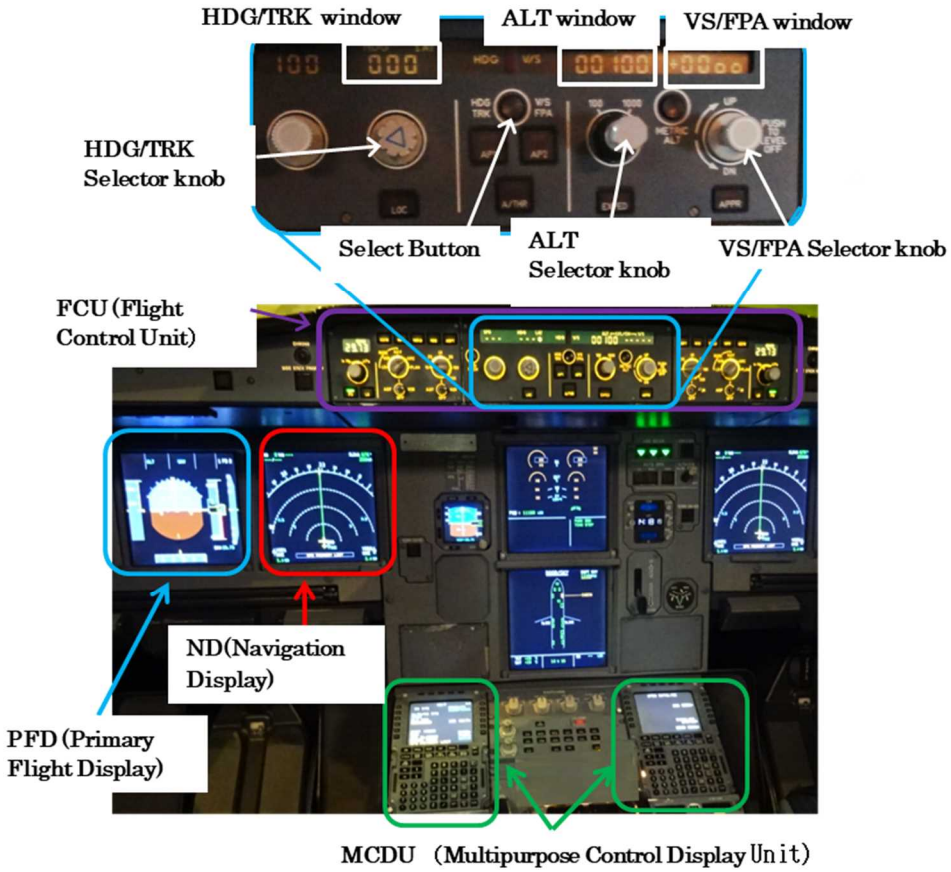

Figure 3 FCU, Instrument Panel and MCDU of the Type

2.9.2 Indication in PFD

PFD incorporates a compass window at the lower, which indicates the flying direction in the range of approximately 40°, a blue triangle symbol (hereinafter referred to as "the HDG (TRK) bug") and a green rhombic shaped symbol are displayed in the window, which indicate selected HDG/TRK

[39] When changing to "TRK/FPA" indication, indication in HDG/TRK window turns to TRK from HDG and indication in VS/FPA window turns to FPA from VS.

and current track respectively.

When pressing Select Button to change to "TRK/FPA" indication, Track Index in blue which indicates selected track and Bird in green appear on the Attitude Director Indicator(ADI). In order to confirm correct alignment to landing runway, a pilot usually checks alignment in a line of the HDG (TRK) bug and rhombic shaped symbol, and in a line of Track Index and vertical line of Bird.

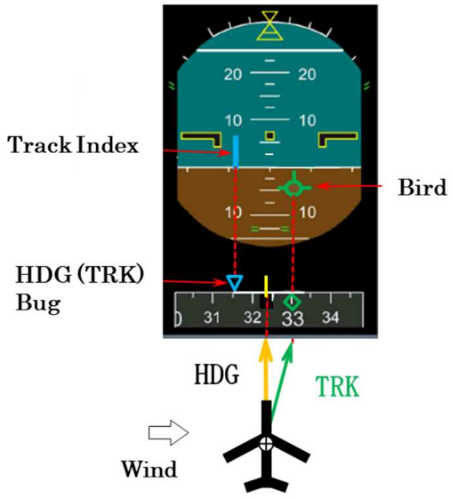

Figure 4 Indication of PFD

2.10 CRM

2.10.1 Threat and Error Management

Human Factors Training represented by CRM/LOFT was traditionally introduced to flight crew members training to prevent the aviation accident originating from Human Error. In the present day, based on the philosophy that Human Error might be inevitable, the concept of "Threat and Error Management (TEM)" is incorporated in flight crew members traing and others as the requirements.

"Threats" are defined as various factors that increase operational complexity and induce errors, which must be managed appropriately to maintain the margins of safety. "Errors" are defined actions or inactions by the flight crew members that lead to deviation from organizational or flight crew member's intention or expectations. In order to perform TEM, flight crew members are required to use their CRM skills[40]. "ICAO DOC-9683 Human Factor Training Manual (hereinafter referred to as "HF training manual") which was issued on 1988 by the the International Civil Aviation Organization, contains the following description[41] (excerpts);

The goal of CRM should therefore be the recognition of threats to safe operations, as a first line of defense, since such threats are the breeding grounds for operational errors. The second line of

[40] CRM skills are competences to perform CRM.
[41] This description is excerpted from 2.3.8 in HF training manual.

defense is the use of appropriate threat management responses to cancel threats, and the recognition of the potential errors that threats might generate. The last line of defense is the use of appropriate error management responses.

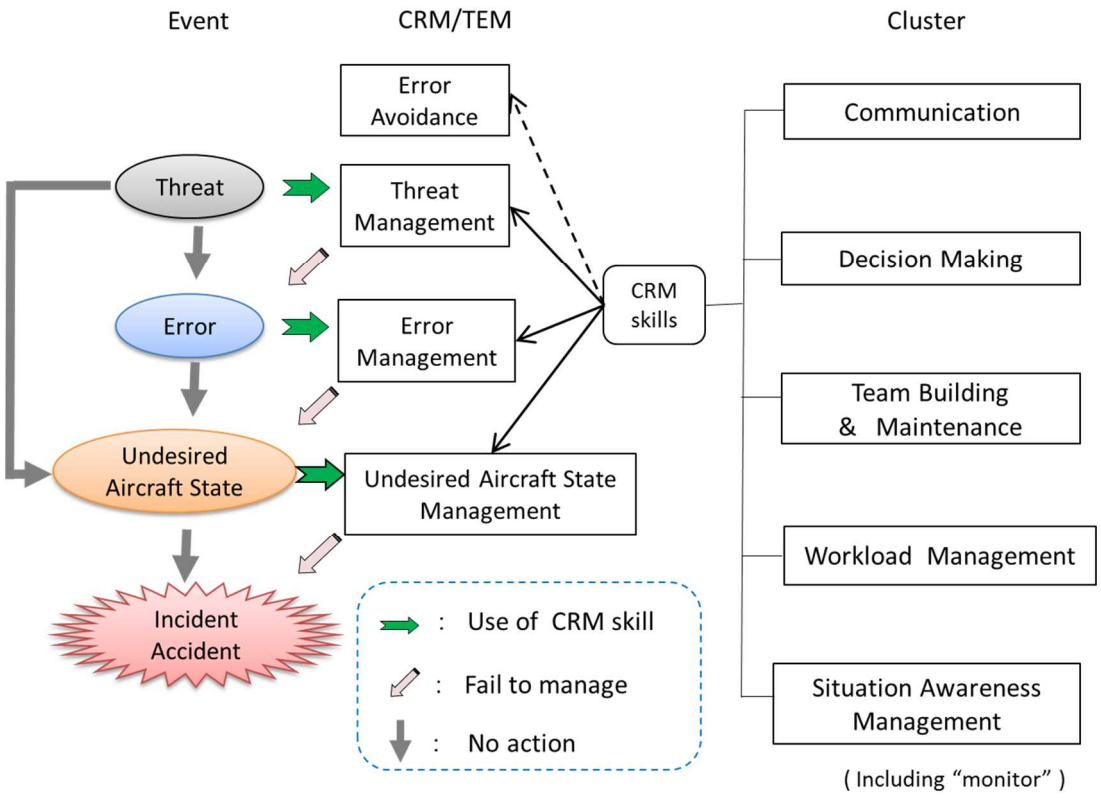

Figure 5 TEM model

(JTSB has compiled from HF traing manual and a material from JAXA [42])

2.10.2 CRM skills

Among CRM skills shown in Figure 5 in 2.10.1, Workload Management, Situation Awareness Management and Communication are listed in Reports by Federal Aviation Administration(FAA) working group[43] and others respectively as follows:

(1) Workload Management

Reports by FAA working group include some descriptions about workload management. A procedures to address the case when there is not enough time allowance is described as follows;

In the WG analysis, high workload and time pressure were common vulnerabilities identified in the factor analysis of incident data.

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[42] Material from Japan Aerospace Exploration Agency(JAXA) stands for "Development for measuring method of CRM skill with behavioral markers" which was issued on July 2009.: JAXA-RR-09-001

[43] "Reports by FAA Working Group" stands for "Operational Use of Flight Path Management systems" issued on September 5, 2013.

Pilots are required to analyze the situation and use their knowledge and skills to assess the situation and prioritize the tasks that need to be done in the time available.

(2) Situation Awareness Management

FAA AC[44] has the following description regarding Monitoring;

Several studies of crew performance, incidents, and accidents have identified inadequate monitoring and cross-checking as vulnerabilities for aviation safety. Effective monitoring and cross-checking can be the last barrier or line of defense against accidents because detecting an error or unsafe situation may break the chain of events leading to an accident. (omitted) Flightcrews must use monitoring to help them identify, prevent, and mitigate events that may impact safety margins.

(3) Communication

"Crew Resource Management:An Introductory Handbook" (hereinafter referred to as "CRM HDBK") created by FAA has remarks to point out that it is important to exchange information within a cockpit and to express ones' concern and advice, positively and explicitly for effective communications. On the other hand, it pointed out that there were many instances where necessary information has failed to convey to person in need even though those information presents there at hand on the background of that information is not transmitted effectively. CRM HDBK also pinpointed that there were many case examples where hazardous events were produced because first officers hesitated to speak up to the captains, therefore, it points out that it is crucial for flight crew members to challenge other person's action and ask for an explanation on her/his behavior if necessary.

2.10.3 Effective TEM

HF training manual has following descriptions regarding "Continuing Reinforcement and development of CRM training[45]." (excerpts)

Effective TEM is based upon operational experience. Using such experience during continuing reinforcement and development of CRM training is essential. The operational experience of each airline is unique and is likely to differ significantly from others. (omitted) The use of the airline's own data produces relevant training programs. Exhaustive examination of actual airline events, and their inclusion in CRM training, delivers the best results.

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[44] Refer to Adivisory Circular(AC) No: 120-71B "SOP and PM Duties for Flight Deck Crewmembers" issued on January 10, 2017 by FAA.

[45] "Continuing Reinforcement and development of CRM training"is described on 2.4.20 in HF training manual.

2.11 Regulation of the Company

FCOM P[46] of the Company defines Crew Duties as follows:

(1) Monitor (excerpts)

(a) PF: Pilot Flying. The PF will mainly take charge to control the airplane and monitor the flight conditions.

(b) PM; Pilot Monitoring. The PM will mainly take charge of duties other than airplane control. The PM monitors operations by the PF and the flight status of the aircraft and make callouts or advice when necessary. (omitted)

(d) In all situations the priority is that the flight crew must continue flying the airplane and monitoring the airplane condition necessary for the flight.

(2) Scan Policy (excerpts)

Non-precision Approach[47]

PF: Add outside view to the panel scan after PM callout "__ in sight."

PM: Call out "__ in sight." After verifying the PF response, scan/monitor the flight and navigation instruments etc carefully, and call out if any abnormalities are recognized,.

Furthermore, Operation Manual (hereinafter refer to as "OM") provides the following qualifications for duty (excerpts);

Pilots qualified as captain

(a) To meet the requirement of recent flight experience stipulated in Civil Aeronautics Law.

(b) To have completed the training and to have passed the check specified in Qualifications Manual[48].

(c) To be Airport qualified according to operational routes.

2.12 Education and Training in the Company

2.12.1 Procedure of Non-Precision Approach and Circling Approach

FCOM describes SOP and others which are recommended by the manufacturer of the Type. When conducting non-precision approach it recommends continuous descent approach, not the step-down descent approach, and when conducting an approach which is not registered in Database like the VOR A approach in the Airport it recommends to use TRK/FPA guidance[49]. However, the Company did not provide educations and trainings preparing for a non-precision approach which is not

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[46] "FCOM P" stands for "Primary" FCOM, in which the Company has stipulated procedures and methods for its flight operations in the course of the flight by the type of aircraft. The FCOM P also provides descriptions of aircraft's systems and materials related to the flight operation. The provisions of FCOM P have precedence of those of FCOM when there is a discrepancy between them.

[47] "Non-precision Approach" is defined as an instrument approach procedure wherein solely azimuth information (lateral direction) is provided without glidepath information (vertical descent angle) during the final approach..

[48] "Qualification Manual" describes that training syllabuses in need to be qualified as a PIC or a first officer and others. First officers are also required to study necessary information on each airport.

[49] When using "TRK/ FPA guidance", a pilot makes a poin to of referring to TRK as the horizontal guidance and FPA as the vertical guidance on the basis that he /she should check raw data to verify flying along the published approach profile.

registered in Database.

Flight crew members in the Company are supposed to conduct VOR runway 06R approach procedure at KIX of non-precision approaches in simulator training, however, since this VOR runway 06R approach procedure is registered in Database, they use FINAL/APP guidance. Furthermore, the Company programs a lesson of circling approach[50] for runway 24L connecting from VOR runway 06R approach in the reccurent training curriculum. A pilot should verify visual references for landing runway to enter the circling approach soon, therefore, in the lesson of circling approach the Company provides an educational training procedure for flight crew members where they are encouraged to reach MDA as quickly as possible and verify associated visual references for landing runway so that they could enter the circling approach course without delay.

Furthermore, FCOM recommends the following procedure at an approach height threshold[51]: in any guidance modes;

- If visual references are sufficienti;

  The PF shall announce "Continue", disengage AD/FD, select TRK/FPA to set the runway track by pushing Select Button and continue approach.
- If visual references are not sufficient;

  The PF shall annaounce "Go-around" and initiate a go around.

2.12.2 Preparedness for VOR A approach by the Company

The Company assigns self-studies to flight crew members in which they shall study the Company-owned airport materials, but it did not monitor their status of knowledge comprehension about the contexts by individual.

Materials on the Airport says about runway operational procedures in the early morning and late-night hours[52] that when runway D closes in the southerly wind condition [53] landing runway might be runway 16L. In addition, the Company had already recognized that aircraft in the Company experienced VOR A approach[54] before the serious incident occurrence, however, the materials did not contain description of information that VOR A approach procedure was not registered in Database.

Furthermore, the Company also created the video materials which covered real approach profiles filmed in the flight simulator as a supplementary tool for materials on the Airport. This video material included the scene of VOR A approach for runway 16L landing in the daytime, however, the Company let flight crew members watch these video material as an option. The Captain and the FO had

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[50] When initiating circling approach, if aircraft was inside of the circling area and visual references are sufficient, a pilot might be allowed to transit to circling approach course at an appropriate point prior to MAPt, however, if aircraft was outside of the circling area, a pilot must get an approval from the Controller.

[51] "An approach height threshold" stands for either Minimum Descent Altitude (MDA) or Decision Altitude (DA).

[52] "Early morning and late-night hours" at the Airport is the time zone of from 14:00 to 20:59 (UTC).

[53] "In the southerly wind condition" is a term described in the Company-own material and differs from "south wind operation" used in AIP.

[54] About 10 flights in the Company had experienced VOR A approach at the Airport before the serious incident.

completed their self-studies of materials on the Airport[55] before the serious incident occurrence, and the FO stated that he had watched the supplementary the video material, while the Captain did not remember if he watched it.

2.12.3 Status of Education, Training and Assessment for the Captain and the FO

The results of major educations and trainings which the Captain and the FO had at the Company are as follows;

< The Captain >

February 12, 2014	CRM (introduction) training
February 25, 2014	Proficiency evaluation to certify as PIC
March 26, 2014	Route evaluation to certify as PIC
August 23, 2014	Recurrent training
August 24, 2014	Recurrent training (LOFT)
September 8, 2014	Recurrent ground school training (including CRM Reviews)
January 12, 2015	Recurrent training
January 13, 2015	Proficiency evaluation
March 9, 2015	Route evaluation
June 19, 2015	Self-Study using materials on the Airport
July 1, 2015	Recurrent ground school training (including CRM Reviews)
July 14, 2015	Recurrent training
July 15, 2015	Recurrent training (LOFT)
January 11, 2016	Recurrent training
January 12, 2016	Proficiency evaluation
April 26, 2016	Route evaluation
August 23, 2016	Recurrent training
September 6, 2016	Recuurent ground school training (including CRM review[56])
September 7, 2016	Recurrent training (LOFT)

< The FO >

October 28, 2015	CRM (introduction) training
November 20, 2015	Completing PTRT[57]
March 5, 2016	Proficiency evaluation to certify as first officer
May 10, 2016	Self-Study using materials on the Airport

[55] "Self-study of materials on the Airport" is a required subject for PIC's airport qualification.
[56] In "CRM review" in 2016", TEM /ASSERTION was the main theme.
[57] "PTRT" is an abbreviation of Pre Type Rating Training and is six-day long general ground school training which the Company provided for first officers who have not experienced to operate or fly a mid-sized jet, including the subjects of "two man crew concept", "CRM skills" and others.

August 13, 2016 Route evaluation to certify as first officer

August 23, 2016 Recurrent training (LOFT)

August 24, 2016 Recurrent training

October 14, 2016 Training as needed [58]

October 21, 2016 Recurrent ground school training (including CRM Reviews)

As mentioned above, the Captain after his certification as a PIC on March, 2014, and the FO after his qualification as a first officer on May, 2016, had taken training and evaluation sessions periodically before the serious incident occurrence. Both of them had good records on the overall evaluation including competencies of management and monitoring and others.

2.13 Flight Operating Management of the Company

2.13.1 Channel of communication when an irregular operation occurred

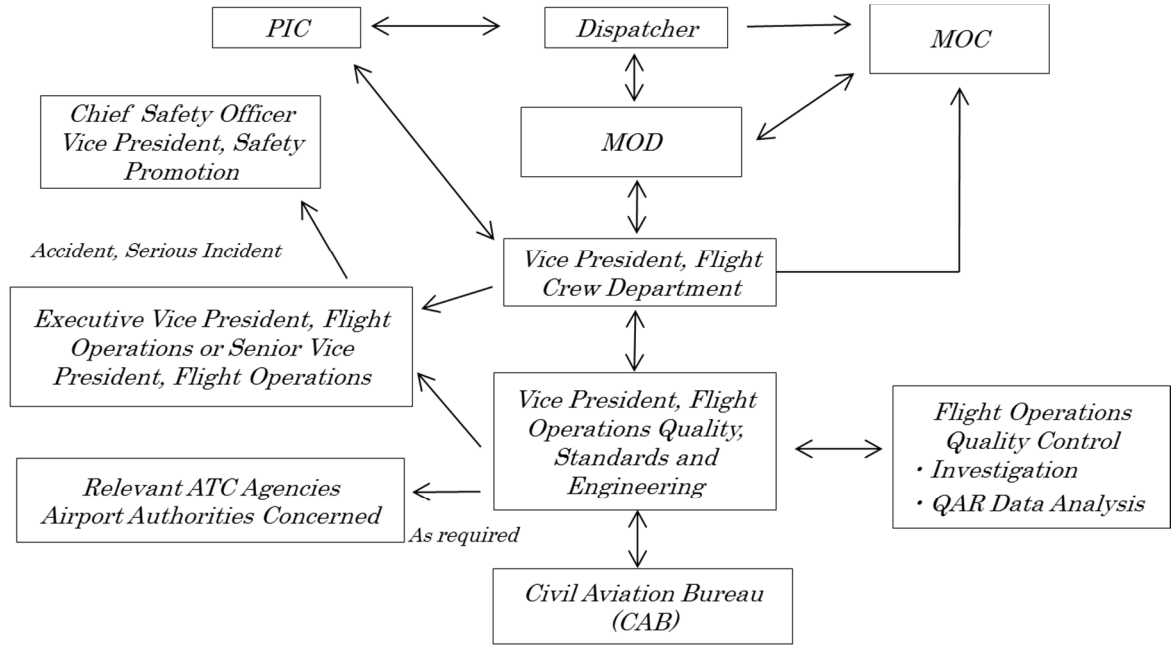
Operation Control Center (hereinafter referred to as “OCC”) manages the daily flight operation in the Company, where a manager on duty (hereinafter referred to as “MOD”) has been placed to complehensively take control and responsibility for the overall flight operations and a dispatcher monitors each the Company’s flight operation. However, at the time of the serious incident occurrence, the Company had organized the structure where MOD served as a dispatcher concurrently [59] (hereinafter referred to as "MOD-Dispatcher" for MOD at the time of the serious incident occurence) .

The Irregular Operation Handbook of the Company (hereinafter refer to as "the HB") stipulates the channel of communication when an irregular operation occurred as follows:

In addition, contacts among responsible persons in each department shown in Figure 6 are supposed to be carried out in a face-to-face manner or on the phone. (excerpts)

[58] “Training as needed” was an additional training provided as a safety measure for the Company’s serious incident occurred on April 2014.

[59] The Company had established the structure where a MOD concurrently served as a dispatcher only in the early morning and late-night hours.



(Note) MOD : Manager on Duty
MOC : Maintenance Operation Controller

Figure 6 Channel of communication when an irregular operations occurred

1) Report when an event occurred

When an event applicable to report occurred or when there is a concern that an event might be applicable to report, PIC shall report the event and others to the dispatcher immediately after completing her/his flight duty and the dispatcher shall contact MOD. (omitted) MOD should not judge or conclude on her/his own whether it might be applicable to an aviation accident or a serious incident and others and MOD should realize that the unexpected situation might happen, in which the event might be later determined to be an accident or incident, hence, MOD is required to share information along the chart of channel of communication.

(omitted)

6) When the event was actually or possibly determined as an accident or a serious incident

When Civil Aviation Bureau (CAB) possibly might determine the event as an accident or a serious incident, MOD shall ground the aircraft and concurrently direct MOC to preserve CVR, FDR and other devices in the present status which might be appointed as objects to be preserved.

(omitted)

2.13.2 Interviewing persons involved with flight operation control

Persons involved with flight operation control stated about the situation when they knew the occurrence of irregular operation caused by the Aircraft as follows;

(1) MOD-Dispatcher

MOD-Dispatcher received the First Report from the FO then asked to phone the manager of flight

crew department. Then he sent bulk e-mailed[60] to every persons involved in the Company that the Airraft made an approach to a wrong runway. After this, he had a concern that the reported event might possibly be applicable to "Attempted landing to closed runway" listed in serious incidents, however, he could hardly be confident of it. In the office of the Company he had no persons to consult and he hesitated to call his superior because it was midnight, then he gave his priority to the task of handling another departing flight. Afterward, he received the Second Report from the FO. Then , MOD-Dispatcher believed that the Second Report would be more true rather than the First Report beacause the FO told him to revise the First Report. In addition, he did not send the context of the Second Report by bulk e-mail.

(2) Manager in flight crew deaprtment

When receiving the First Report from the FO, manager in flight crew deaprtment did not recognize the status of runway 23 which was closed. Therefore, he calculated that the event might be deemed as matters of altitude deviation or ATC violation and he directed the FO to submit a report. And later, he received and checked the report which covered the context of the Second Report.

(3) Manager in safety promotion department

Manager in flight safety promotion department saw context of the bulk-email from MOD-Dispatcher after wake-up and then he direcrted the specific division to analyze the QAR[61] data. Afterwards, he received the flight track report from the analysis team that the Aircraft seemed to be approaching for runway 23 with descending. Accordingly, he gave the frist report to Civil Aviation Bureau (CAB) that the Company had an event which might be possibly applicable to a serious incident.

2.13.3 Duties and Appointment of MOD

(1) Tasks and Responsibilities

The HB described that a dispatcher should get an accurate picture about the event which flight crew members reported and convey it to MOD, and MOD should organize information correctly based on the checklist. Moreover, it prescribed that when an irregular operation, an incident or an event which might possibly be applicable to an incident occurred MOD should direct that aircraft should remain grounded until full communication among relevant divisions in the Company was established and MOD should take actions to preserve devices such as CVR in the present status.

(2) Qualification Process of MOD and Education and Training for MOD

The Company basically seeks that candidates for MOD should be deeply familiar with jobs

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[60] The Company took advantage of bulk e-mail as the tool for sharing information.
[61] "QAR" is a recording device which is capable to record flight data comparable to FDR data. The operator can be able to program its own parameters on it.

about airport flight operation. It mandatorily provided them with ground school lessons of eleven hours and OJT session of six days, and after completion of them it qualified them as MODs. However, since it did not stipulate any requirements to retain their qualification of MOD, those who once qualified as MOD could maintain their status without any periodic schoolings.

(3) Requirement for serving as MOD-Dispatcher

MOD personnel is categorized into two status in the Company: one is a group comprising of MODs who are competent to fulfill MOD's duty regardless of daytime or nighttime, and other is a group of MODs who can serve only in early morning and late night hours. MOD-Dispatchers could take charge of their tasks only in early morning and late night hours. Furthermore, the Company did not stipulate the requirement for MOD to concurrently serve as a dispatcher.

2. 14 Measures to a temporarily closed runway

2.14.1 Provisions in ICAO Annex 14

Concerning a closed runway, ICAO Annex 14 has provisions as follows; (excerpts)

7.1 Closed runways and taxiways, or parts thereof

7.1.2 Recommendation – A closed marking should be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.

2.14.2 The Circular by FAA of U.S.A

FAA AC "Operation Safety on Airports During Construction"[62] has the following description;

Temporarily Closed Runways.

If available, use a lighted X, both at night and during the day, placed at each end of the runway facing the approach. The use of a lighted X is required if night work requires lighting to be on.

Figure7 X-mark sign on a temporarily closed runway

[62] "Operation Safety on Airports During Construction" is AC No: 150/5370-2F issued on September 29, 2011 by FAA.

3. ANALYSIS

3.1 Qualifications of Flight Crew Members

Both the Captain and the FO held both valid airman competence certificates and valid aviation medical certificates.

3.2 Aircraft Airworthiness Certificate

The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed.

3.3 Relations to the Meteorological Conditions

As described in 2.6, it is highly probable that the meteorological condition had no effect on the serious incident.

3.4 History of the Flight

3.4.1 Situation at the time of receiving the instruction to change to VOR A approach

As described in 2.1.2 (1), it is probable that the Captain gave a briefing for ILS Y approach for runway 34R during cruise and confirmed the closure of runway D.

As described in 2.1.1, Tokyo Approach reported to the Aircraft that it was supposed to land on runway 34R via ILS Y approach at 00:24:01 but afterwards he reported that runway change was in progress and he expected it to land on runway 16L via VOR A approach at 00:26:26. As described in 2.1.2 (1), it is probable that since the Captain did not expected a runway change at all and it was flying at an altitude of approximately 10,000 ft around UTIBO he was amazed by the sudden instruction to change the landing runway under the situation where it was flying so close to the Airport. However, it is probable that he accepted the ATC instruction because the Captain himself had some experiences to land on runway 16L, judging from a meteorological condition there at that time.

On the other hand, it is probable that the Captain and the FO ended up starting an approach without FMGC setting because VOR A approach procedure was not registered in Database. According to the statement of the FO, it is somewhat likely that when the Aircraft passes DARKS possible indications of MCDU and ND were imaged as shown in Figure 8.

Figure 8 Estimated indication of MCDU and ND when passing DARKS

(This drawing is for illustrative purpose only)

3.4.2 Situation of Approach Briefing

As shown in Appended Figure 1, the interval time from when the Aircraft was announced the possible approach procedure change to VOR A approach by Tokyo Approach to when passing KAIHO was about five minutes. It is probable that after being announced this notification the FO started following the Captain's order to modify MCDU, however, he got confused and it took quite a long time to realize that VOR A approach was not registered in Database. As described in 2.1.2 (1), it is probable that the Captain tried to give an approach briefing once again because the approach procedure changed from ILS Y approach to VOR A approach, however, he could not have enough time to brief and, in practice, he could barely manage to do on the way to DARKS.

It is probable that because workload level of the Captain was soaring in the descending and decelerating flight phase from KAIHO to DARKS while lowering flaps the Captain could not help but giving his approach briefing in a rushed manner. Therefore, it is probable that he could referred to the approach chart of VOR A approach but failed to review the chart of preferential route for noise abatement described in 2.8.4. As the result, it is probable that he commenced VOR A approach in the state that he did not hold in mind specific images of how runway 16L looked and turning right to enter the circling approach while conducting VOR A approach.

3.4.3 Situation When Commencing Approach

As described in 2.1.2 (1) the Captain stated that he verified setting of HME at MCDU, it is probable that he commenced the approach referring to the needle of VOR and indication of DME on ND in the state of no FMGC setting of VOR A approach due to no registeration in Database. As shown in Appended Figure 5, the Aircraft had began descending with HDG mode [A][63] and VS mode [B] , and those mode had been maintained until when AP/FD was disengaged. Furthermore, as shown in

[63] In this section of Analysis, the alphabet in [ ] refers to "A to I" used in Appended Figure 5.

Appended Figure 3, it descended below 1,100 ft, which was the lower limited altitude of SAZAN. It is probable that it is because the Captain and the FO were not familiar with the procedure in which they should make the approach referring to the approach chart in the state of no FMGC setting and accordingly their crosschecks for the approach profile ended up to become insufficient. In addition, it is somewhat likely that it was a contributing factor for the altitude deviation that the Captain intended to reach Minimum Descend Altitude(MDA) quickly in order to identify the landing runway following the circling approach procedure which was instructed at the recurrent training in the Company.

3.4.4 Situation around the time of leading up to MDA

As shown in Appended Figure 5, when the Aircraft reached MDA of 760 ft [C], the vertical speed, Selected V/S, was changed to 0 fpm [D], it is probable that the Captain was trying to maintain MDA because but the Aircraft descended below MDA and continued gradual descending even after AP/FD was disengaed [E].

It is probable that the Captain was confused about that he could not find landing runway 16L which should have been seen right in front of him and he went further to concentrate himself on seeking for it. Accordingly, it is probable that he descended below MDA without identifying runway 16L.

In addition, as described in 2.1.2 (2), it is probable that the FO was not familiar with the Airport and he was so busy referring the approach chart and meeting the Captain's order in which he should lower flaps and do others in the phase after passing DARKS. Consequently, it is probable that the FO had been engaged with referring to approach chart and handling tasks of flap operations and others ordered by the Captain, then he had fallen out to the state that he could neither monitor the altitude or the path of the Aircraft nor crosscheck the Captain's maneuvering as PM, and then he could neither examine where runway 16L located nor provide any advice to the Captain when the Aircraft descended below MDA as PM.

3.4.5 Situation up to Go-around

As described in 2.1.2 (1), the Captain stated that when he saw runway 23, which was closed, brightly lighted in left front of him he instinctively let the Aircraft turn to the direction. As shown in Appended Figure 5 [E], [F], after disengaging AP and changing to manual control the Aircraft turned left and descended. It is probable that he was mistakenly tried to approach to runway 23 at that time. Afterward, it is probable that the Captain instructed the FO to set runway track of 157° [G] and TRK/FPA [H] but he noticed that "HDG (TRK) bug" and "Track Index" were not appeared on PFD and that the current HDG shown the direction of 230°, and then he felt odd and realized that the runway right in front of him might not probably be runway 16L but runway 23 which was being closed.

On the other hand, as described in 2.1.2 (4), it is probable that Tokyo Tower instructed the Aircraft to make a go-around because it looked descending toward runway 23, which should have flown toward the downwind of runway 16L. It is probable that Tokyo Tower instructed it to make a right climbing turn immediately because he needed to maintain a traffic separation between the departing aircraft from runway 16L and the Aircraft.

3.5 Advance Preparation

It is probable that even though the Captain and the FO completed their self-study of materials on the Airport as described in 2.12.2 and the Captain held the airport qualification of the Airport defined in OM as describeb in 2.11, they did not assume that VOR A approach might come into operation when runway D closed in south wind operation.

As described in 2.12.1, when conducting an approach which is not registered in Database, FCOM recommends to use TRK/FPA guidance[64]. It is probable that when conducting VOR A approach, a pilot is supposed to fly for HME along the course of 274° and establish TRK mode, and then he/she descend in accordance with the approach profile. The Company did not provide trainings with flight crew members in preparation for the case in which they conduct a non-precision approach which is not registered in Database. Furthermore, it is probable that the Captain and the FO did not learn and master the practical procedures for conducting VOR A approach and their advance preparation for VOR A approach was not sufficient.

It is probable that it is necessary for flight crew members to study every possible approach-types in planned airports and imagine how to fly in advance so that they can give themselves plenty time of addressing even when a sudden approach-type change is instructed.

3.6 Performance of TEM and CRM/TEM Education and Training in the Company

3.6.1 Performance of TEM by the Captain and the FO

(1) Performance of TEM by the Captain

As described in 2.10.1, effectively performing TEM, flight crew members shall recognize the event which might be in danger of threatening safe flight operations as a "threat." However, it is probale that the Captain failed to recognize the ATC instruction of landing runway change as a threat when the serious incident occurred.

In addition, as described in 3.4.2, it is probable that the FO got confused after starting to modify MCDU and it took quite a long time to do it. It is probable that the Captain realized the FO's confusing situation, however, the Captain did not try to control the time and failed to manage their workload. Moreover, it is probable that because he was in the state that he did not built his own practical flying

[64] When using "TRK/FPA guidance," a pilot is supposed to use TRK for a horizontal direction and FPA for a vertical direction on the basis that he/she verifys that aircraft is following the published approach profile by monitoring raw data.

image of VOR A approach he commenced the approach without giving a sufficient briefing. As described in 2.10.2(1), report by FAA working group says that high workload and time pressure were common vulnerabilities identified in the factor analysis of incident data, and pilots are required to analyze the situation and use their knowledge and skills to assess the situation and prioritize the tasks that need to be done in the time available. It is probable that the Captain should have managed their workload or prioritized their tasks properly within a restricted time frame and should have commenced the approach after providing a sufficient briefing. In addition, it is probable that if he recognized short of time he should have considered that he had multiple options such as request for changing of approach procedure, request for holding, or request for radar-guidance and others.

(2) Performance of TEM by the FO

As with the Captain, it is probale that the FO also fail to recognize the ATC instruction of landing runway change as a threat when the serious incident occurred.

As described in 2.1.2 (2), the FO stated that he saw ALB which was a reference for runway 16L landing and that when the Captain let the Aircarft turn left for trying to align to the runway, he had a question about the difference of approach course to ruwany 16L between what he imagined before and what he actually saw at the moment. However, it is probable that he excessively relied on the Captain who had considerably experienced and he had unnecessary hesitation to ask him about it. Therefore, it is probable that he did not give sufficient and possitive advice. As described in 2.10.2(3), CRM HDBK says that it is important to express ones' concern and advice positively and explicitly for effective communications and that it is crucial to challenge other person's action and ask for an explanation on her/his behavior if necessary. It is probable that the FO should have proactively provided advice on matters he had noticed and questioned without any hesitaions.

As described in 2.11, FCOM P of the Company stipulates that PM shall monitor the flight status of the aircraft and operations by PF and make callouts or advice when necessary and as described in 2.10.2 (2), FAA AC specifies that effective monitoring and cross-checking can be the last barrier or line of defense against.

In addition, as described in 3.4.4, it is probable that the FO had been engaged with referring to approach chart and handling tasks of flap operations and others ordered by the Captain, then he had fallen out to the state that he could neither monitor the altitude or the path of the Aircraft nor crosscheck the Captain's maneuvering as PM.

3.6.2 Education and Training of CRM/TEM

As described in 2.12.3, the Company provided introducrion training of CRM for flight crew members' candiates and PTRT for first officers' candiates who did not experience middle-sized jet-airliner. Moreover, the Company periodically provided LOFT training and ground school training and

it educated flight crew members in the Company pursutant to annual CRM theme in the ground school curriculum of CRM review. It is probable that it had provided various education and training of CRM/TEM for flight crew members. However, when the serious incident occurred, it is probable that the Captain and the FO could not perform TEM properly.

It is somewhat likely that this situation was created because CRM skills in CRM/TEM of the Captain and the FO were not sufficiently taken root in themselves in the education and training for CRM/TEM which the Company had ever provided.

It is probable that the Company should examine its own education and training curriculum of CRM so that it has flight crew members establish TEM sufficiently; when flight crew members encountered various facors that might increase operational complexity and induce errors during day-to-day flight operation, they could recognize such events as threats and then they could become to use CRM skills properly and perform TEM practically. As described in 2.10.3, it is probable that it might become another effective way for the Company to verify events it had ever experienced complehensively and reflect them to the curriculums in education and training of CRM/TEM.

3.7 Compliance with SOP

During approach for the Airport, it is probable that the Captain could see the bird-eye view of the Airport, however, he could not identify runway 16L to be landed on since he did not have a specific image of how runway 16L might look. Accordingly, it is probable that the Aircraft might descend below MDA when he remained not to identify runway 16L. When the serious incident occurred, the Captain should have observed "scan policy during non-precision approach" described in 2.11 and maintained MDA until he received PM's call-out of "~ in sight" and identified the landing runway. Furthermore, the FO should have pointed out this error which the Captain made.

As described in 2.12.1, FCOM prescribed standard operation procedure (SOP) in order to perform safe flight operation. In this case, it is probable that the Captain, following SOP, should have continued approach while maintaining MDA, the Captain and the FO should have excuted a go-around when they were remained in the state of that they could not identify runway 16L for sure.

3.8 Collecting and Utilizing Risk Information and Monitoring their Comprehension Status of Knowledge in the Company

As described in 2.12.2, the Company stated that it recognized that the Compnay's aircraft had experienced VOR A approach before the serious incident occured, and it is probable that flight crew members in the Company, at any cases in the past, had worked on properly and conducted VOR A approach normally. Therefore, it is probable that the Company had not considered any risks which generated when they conducted an approach which was not registered in Database. The Company did not take such actions in which it edited materials on the Airport about information to the effect that

VOR A approach in the Airport was not registered in Database.

Furthermore, the Company assigned self-studies to flight crew members in which they should study airport materials, however, it did not monitor their status of knowledge comprehension about the contexts by individual, and it also created the video materials which covered real approach profiles as a supplementary tool, however, it let flight crew members watch the video materials as an option. The Captain and the FO could not conduct VOR A approach properly when the serious incident occurred. It is somewhat likely that this situation was created because there were background factors of the Company's insufficient practices: the Company had not collected or utilized risk information, and it had also not monitored flight crew members' comprehension status of knowledge.

3.9 Communications between the Air Traffic Control authorities and a pilot

As described in 2.1.2 (1), it is probable that when the serious incident occurred the Captain never expected the possibilities that approach procedure or landing runway might be changed because the weather information did not indicate any changes.

Moreover, as described in 2.8.7, pilot of airacraft A, which was succeeding to the Aircraft, was instructed to change to VOR A approach requested ILS approach, pilot of aircraft B was surprised, and both pilots of the aircraft C and aircraft D reported that they could not conduct VOR A approaches. It is somewhat likely that not only the Captain but other pilots of aircraft succeeding to the Aircraft also could not expect changes in approach procedure or landing runway in the Airport at the time.

However, as described in 2.1.2 (3) and (4), the Controllers are saying that ATC facilities decide using runway based on not only weather conditions but also aircraft operating procedures for noise abatement at the Airport described in 2.8.4 or considerations for efficient handling of traffic flow of takeoff and landing aircraft. Taking these terms and conditions into account, it is probable that a pilot should expect that runway change and other events might possibly happen at any time and she/he should take proper actions depending on the time and situation such as requesting holding in order to secure the preparation time.

On the other hand, it is desirable that ATC facilities should re-realize that instruction for runway change during descnent could become a threat for a pilot. Moreover, it is desirable that ATC facilities should consider that pilots ' workload might increase when the Controller issues an instruction of runway change in the similar situation as when this event occurred in which there were reasons other than weather condition changes, and it is desirable that they should provide runway change information for pilots as early as practicable.

3.10 Actions of the Company corresponding to the Irregular Flight

As described in 2.13.2 (1), after receiving the First Report, MOD-Dispatcher recognized that runway 23 was closed when the event occurred, therefore, it is probable that he should have realized

that this event could be applicable to " Attempt landing to closed runway" which was listed in serious incidents.

As described in 2.13.3 (1), the Company stipulates that MOD shall assume responsibilities for continuation of aircraft operation and as described in 2.13.1, when an event occurs, she/he should not judge or conclude on her/his own whether it might be applicable to an aviation accident or a serious incident and others, and she/he needed to share information and confer with each deaprtments.

It is probable that the MOD-Dispatcher had concerned the possibilities that the event might be applicable to a serious incident, however, he did not become convinced because he could not have organized knowledges and he hesitated to have a late-night phone call to consult anyone. And, it is probable that he had then struggled with handling another departing traffic and he could not direct any proper instructions, consequently, it fell out that he allowed the Aircraft to continuously serve for the next flight operation and he did not take actions to preserve CVR and other devices.

It is probable that even when an irregular flight operation occurred at late-night hours, the Company should organize the structure, while MOD plays a leading role and those involved share information closely with each department, in which they can quickly have discussions on the continuation of flght operation and others. It is probable that the Company should evaluate continuously whether the structure works functionally and is managed properly, and it should improve if needed. Furthermore, it is probable that the Company should revise requirement for qualification of MOD and education to be provided for MOD.

3.11 Installing Markings on the Closed Runway and others

When the serious incident occurred, while runway D was closed, the lightings for the runway were turned on due to a periodic maintenance work. As described in 2.1.2 (1), the Captain stated that he recognized that runway D was closed and he believed that closed runway should be completely dark. It is probable that he recognized that he knew that runway 23 was closed by NOTAM, however, he let the Aircraft fly for runway 23 which looked bright in front of him.

It is desirable that administrators in airports should examine to take a measure of placing a closed marking on the temporarily closed runway as described in 2.14, and others, such actions might become countermeasures to prevent from occurring similar human errors.

4. CONCLUSIONS

4.1 Summaries of Analyses

(1) Both the Captain and the FO held both valid airman competence certificates and valid aviation

medical certificates. (3.1)[65]

(2) The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed. (3.2)

(3) It is highly probable that the meteorological condition had no effect on the serious incident. (3.3)

(4) Tokyo Approach reported to the Aircraft that runway change was in progress and he expected it to land on runway 16L via VOR A approach. The Captain did not expected a runway change at all and he was amazed by the sudden instruction, but it is probable that he accepted the ATC instruction. VOR A approach procedure was not registered in Database and the Captain and the FO ended up starting an approach without FMGC setting. (3.4.1)

(5) It is probable that the FO took quite a long time to modify MCDU and the Capatain could not have enough time to prepare and he gave his approach briefing in a rushed manner. As the result, it is probable that he commenced VOR A approach in the state that he did not hold in mind specific images of how runway 16L looked and turning right to enter the circling approach while conducting VOR A approach. (3.4.2)

(6) It descended below the lower limited altitude of SAZAN. It is probable that because the Captain and the FO were not familiar with the procedure, and their crosschecks for the approach profile ended up to become insufficient. It is somewhat likely that it was a contributing factor that the Captain intended to reach Minimum Descend Altitude(MDA) quickly in order to identify the landing runway. (3.4.3)

(7) It is probable that the Captain was confused about that he could not find landing runway 16L which should have been seen right in front of him and he went further to concentrate himself on seeking for it. Accordingly, it is probable that he descended below MDA without identifying runway 16L. It is probable that he had fallen out to the state that he could neither monitor the altitude or the path of the Aircraft nor crosscheck the Captain's maneuvering as PM, and then he could neither examine where runway 16L located nor provide any advice to the Captain when the Aircraft descended below MDA as PM. (3.4.4)

(8) The Captain stated that when he saw runway 23, which was closed, brightly lighted in left front

[65] The number described in the end of each paragraph starting with (1) and so on in this section corresponds with the section in the Chapter 3. ANALYSIS.

of him he instinctively let the Aircraft turn to the direction. It is probable that he was mistakenly tried to approach to runway 23 at that time. On the other hand, it is probable that Tokyo Tower instructed the Aircraft to make a go-around and a right climbing turn immediately because it looked descending toward runway 23, which should have flown toward the downwind of runway 16L. (3.4.5)

(9) It is probable that the Captain and the FO did not assume that VOR A approach might come into operation when runway D closed in south wind operation. Furthemore, it is probable that they did not learn and master the practical procedures for conducting VOR A approach and their advance preparation for VOR A approach was not sufficient. (3.5)

(10) Effectively performing TEM, flight crew members shall recognize the event which might be in danger of threatening safe flight operations as a "threat." However, it is probale that the Captain failed to recognize the ATC instruction of landing runway change as a threat when the serious incident occurred. It is probable that the Captain did not try to control the time properly and failed to manage their workload. Moreover, it is probable that because he was in the state that he did not built his own practical flying image of VOR A approach, he commenced the approach without giving a sufficient briefing.

Furthermore, the FO stated that he had a question about the difference of approach course to ruwany 16L between what he imagined before and what he actually saw at the moment. However, it is probable that he excessively relied on the Captain, he had unnecessary hesitation to ask him about it. and he did not give sufficient and possitive advice. In addition, it is probable that the FO fell out reached to the state that he could neither monitor the altitude or the path of the Aircraft nor crosscheck the Captain's maneuvering as PM. (3.6.1)

(11) Regarding that the Captain and the FO could not perform TEM properly, it is somewhat likely that this situation was created because CRM skills in CRM/TEM of the Captain and the FO were not sufficiently taken root in themselves in the education and training for CRM/TEM which the Company had ever provided. (3.6.2)

(12) During approach for the Airport, it is probable that the Aircraft might descend below MDA when the Captain remained not to identify runway 16L. It is probable that the Captain, following SOP, should have continued approach while maintaining MDA, the Captain and the FO should have excuted a go-around when they were remained in the state of that they could not identify runway 16L for sure. (3.7)

(13) It is probable that the Company had not considered any risks which generated when flight crew members conducted an approach which was not registered in Database. The Company did not take such actions in which it edited materials on the Airport about information to the effect that VOR A approach in the Airport was not registered in Database. The Company did not monitor the status of knowledge comprehension about the contexts of self-study about materials on the Airport. The Captain and the FO could not conduct VOR A approach properly when the serious incident occurred. It is somewhat likely that this situation was created because there were background factors of the Company's insufficient practices: the Company had not collected or utilized risk information, and it had also not monitored flight crew members' comprehension status of knowledge. (3.8)

(14) It is probable that a pilot should expect that runway change and other events might possibly happen at any time and she/he should take proper actions depending on the time and situation such as requesting holding in order to secure the preparation time. On the other hand, it is desirable that ATC facilities should re-realize that instruction for runway change could become a threat for a pilot. It is desirable that they should provide runway change information for pilots as early as practicable. (3.9)

(15) It is probable that the MOD-Dispatcher had concerned the possibilities that the event might be applicable to a serious incident, however consequently, it fell out that he allowed the Aircraft to continuously serve for the next flight operation. It is probable that even when an irregular flight operation occurred at late-night hours, the Company should organize the structure, in which each department can quickly have discussions on the continuation of flight operation and others. It is probable that it should evaluate continuously and it should improve if needed. Furthermore, it is probable that it should revise requirement for qualification of MOD and education to be provided for MOD. (3.10)

(16) It is probable that the Captain recognized that he knew that runway 23 was closed by NOTAM. However, he let the Aircraft fly for runway 23 which looked bright in front of him. It is desirable that administrators in airports should examine to take a measure of placing a closed marking on the temporarily closed runway and others, such actions might become a countermeasure to prevent from occurring similar human errors. (3.11)

4.2 Probable Causes

It is probable that the serious incident occurred because aircraft, conducting VOR-A approach to land on runway 16L of Tokyo International Airport, mistakenly tried to approach for runway 23 which was closed.

It is probable that the aircraft mistakenly tried to approach for runway 23 which was closed because advance preparations for VOR A approach by the captain and the first officer were not sufficient, and they could not recognize the runway change instruction to land as a threat and then they failed to manage workloads, properly monitor and advise.

5. SAFETY ACTIONS

5.1 Safety Actions Taken

5.1.1 Safety Actions Taken by the Company

Peach Aviation Co., Ltd. took the following measures in order to prevent similar events from occurring after the serious incident occurred:

(1) Provision of information to flight crew members

Right after the serious incident occurred, the Company issued documents which encouraged flight crew members to stick to the basics in their flight operations, in which it urged to remind the importance of their readiness before conducting an approach, observe SOPs and make positive assertions and others. And it also alerted them that VOR A approach was not registered in Databse and it was difficult to identify runway 16L in the night-time. In addition, it issued technical information to introduce them with how to modify VOR A approach on MCDU as an interim procedure on January 6, 2017.

(2) Measures for Flight Operations

The Comapany registered VOR A approach in Database on February 2, 2017. (See Figure 9) Furthermore, it illustrated specifc recommended procedures and guiding flight course when transitting to circling approach from VOR A approach and it offered measures for flight crew members to perform VOR A approach successfully. In addition, it introduced the computer-based learning system in the office on February 9, 2017 to support advance preparations of flight crew members

, in which they could review NAV data by themselves.

Other than this, the Company added the contents of the material of "Schedule of Periodic Runway Closure Schedule and Operational Pattern" on runway usage at HND in late-night and early-morning hours which was provided by CAB as described in 5.1.2, and revised materials on the Airport.

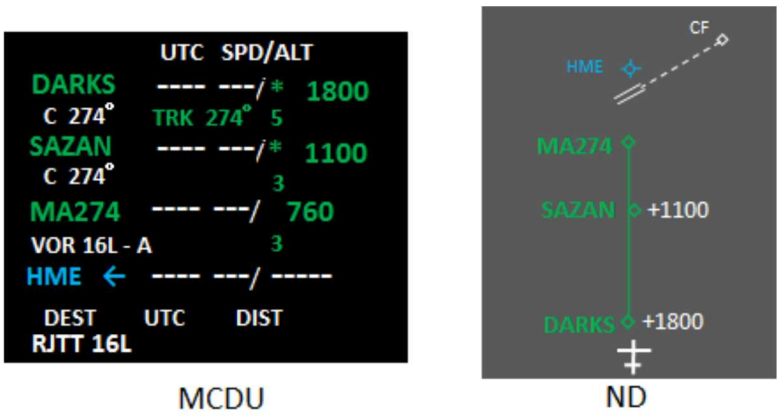


Figure 9　NAV data Indictaion of Registered VOR A approach

(This drawing is for illustrative purpose only)

(3) Measures for Training of Flight Crew Members

The Company decided that flight crew members should conduct VOR A approach practice in the night-hours setting in recurrent simulator training for fiscal 2017.

Then the Company extended the self-study time relevant to airport qualification to one hour and thirty minutes from one hour. Regarding watching video materials, filmed in the simulator, described in 2.12.2, it incorporated watching them to mandatory lesson items, and it obliged those captains who need to newly obtain their airport qualification of the Airport and those first officers who need to get knowledge about the Airport to watch the video materials. Furthermore, it made flight crew members compulsory to take a knowledge examination to confirm their knowledge status in the self-study relevant to airport qualification.

(4) Examination of Approach Procedures to be Registered

In keeping with possibility that flight crew members in the Company might conduct an approach procedure which is not registered in Database, it started to examine how to specifically and practically conduct an unregistered approach including promotion to newly register them in Database. All about new airport became in sevice, it investigated what approach should be registered and moreover it started to examine the need of visual materials.

(5) Restructuring in Operaion Control Department

The Company provided those who personnel qualified as MOD with the on-demand training which included review of the contents described in the HB and centered on practical exercises based on case-study. It discussed countermeasure prepared for the time when personnel in Operaion Control Department received a report on occurrence of irregular operation and it established the framework to support for MOD systematically: it widely disseminated that MOD

should contact the director in OCC at any hour of day or night if there were a possibility of the serious incident.

The Company decided some requirements for MOD-candidates such as that she/he should have practical experiences of dispatcher-works for more than one year and it also made it its business that it improved the quality of curriculum in MOD-qualification training and it made them compulsory to take a knowledge examination after the training program was completed, moreover, it took the measurements to maintain MOD-qualification that MOD should take recurrent trainings and be checked their knowledge status every two years.

Furthermore, the Company revoked the system that MOD served as a dispatcher concurrently after February 18, 2017 and it updated the duty assignment of those who concerned personnel with flight operation control in the traffic congested time zone and made a rule of allocating three personnel in every hours. In addition, it decided that it evaluated the framework of flight operation control continuously, re-examined it if needed, and confirmed periodically in the in-house safety audit.

5.1.2 Measures taken by Civil Aviation Bureau (CAB) of MLIT

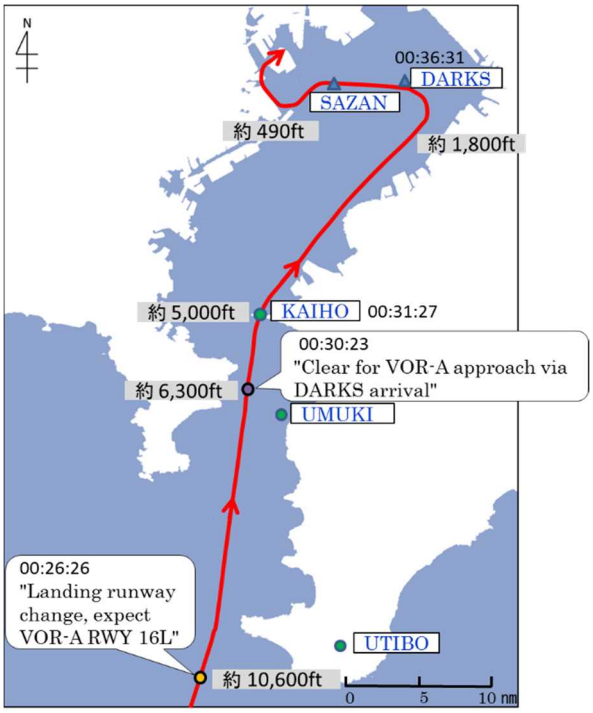
After evalutauing the serious incident the CAB implemented the following countermeasures to prevent recurrence of the similar events;

(1) Tokyo Airport Office in the East Japan Civil Aviation Bureau provided the materials (See Appended Figure 9.) of "Runway Closure Schedule and Operation Pattern" at HND in late-night and early-morning hours issued on January 27, 2017 to operators via FGSC[66] and sought to share information.

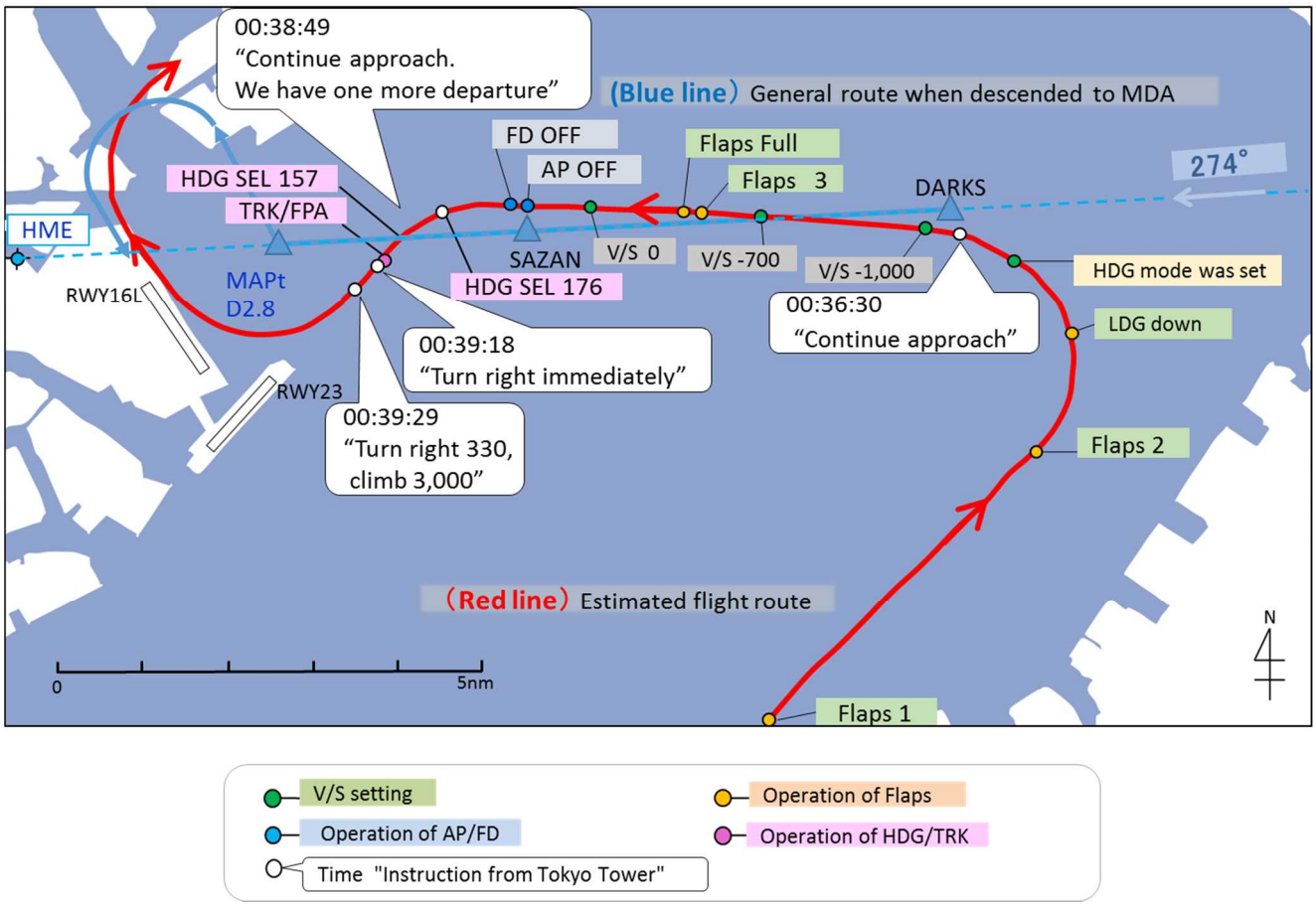
(2) Air Traffic Control Division in the CAB revised the approach chart of VOR A approach procedure in AIP in which some notes were appended, coming into force in December 07, 2017.

[66] "FGSC" is a subcommittee to exchange opinions between operators and Air Traffic Control Authorities.

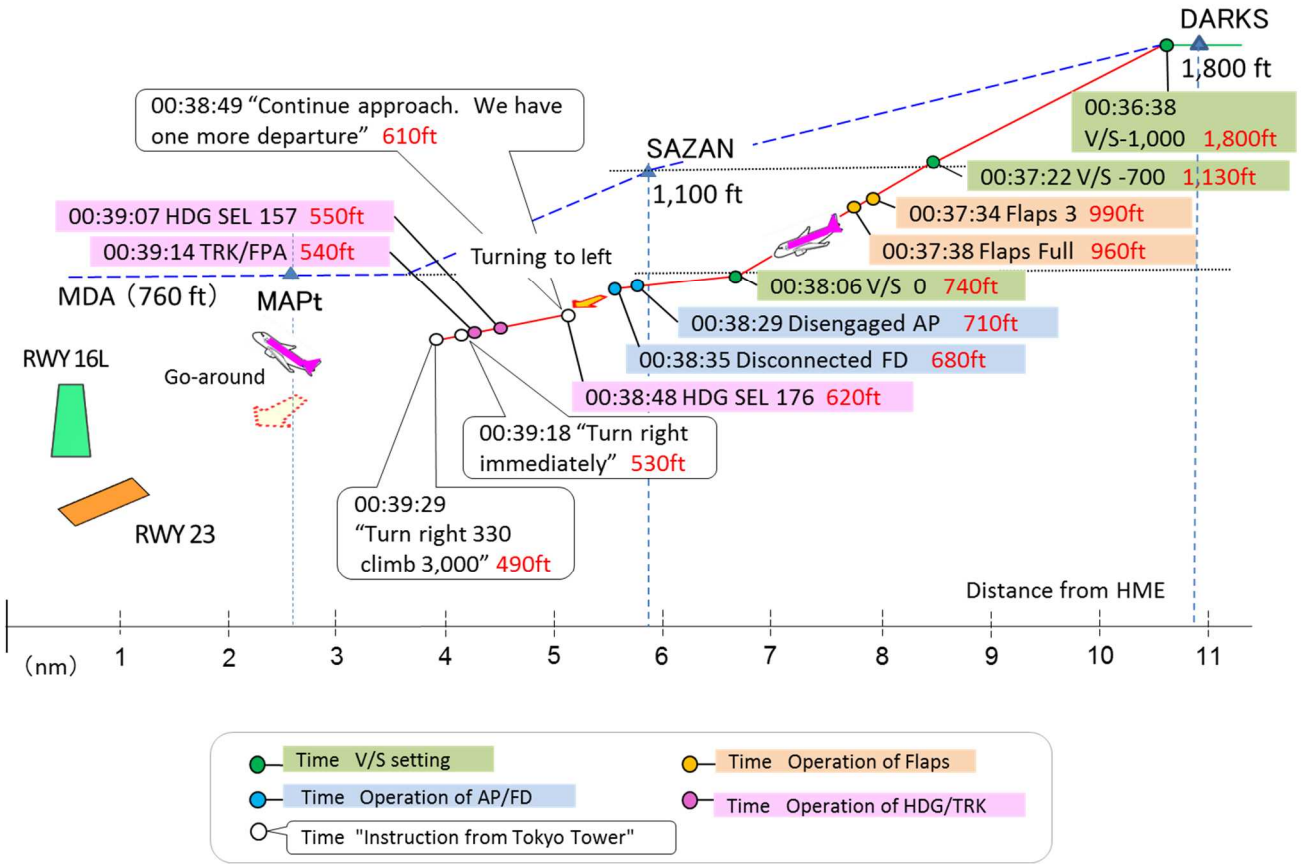
Appended Figure 1 Estimated Flight Route （1）



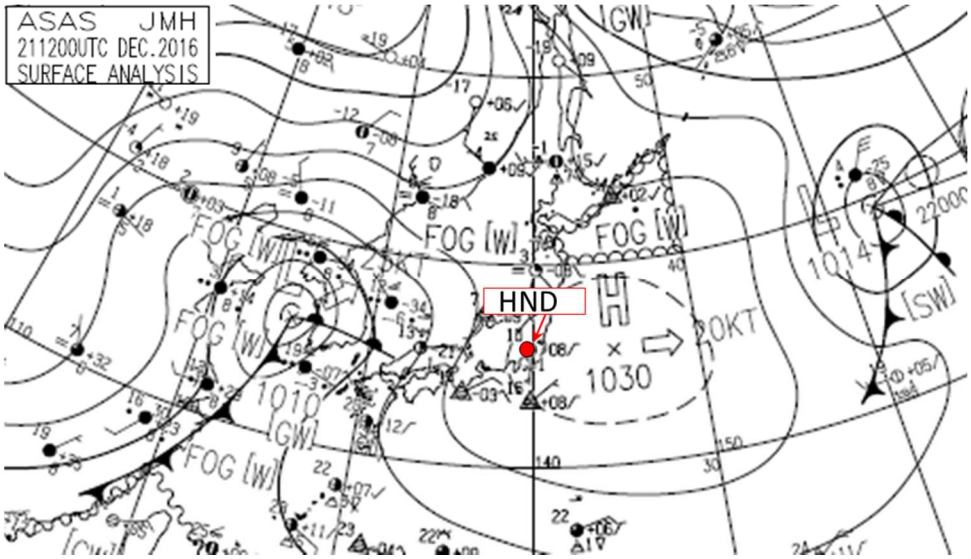
Appended Figure 2 Estimated Flight Route （2）



Appended Figure 3 Estimated Flight Route (3)

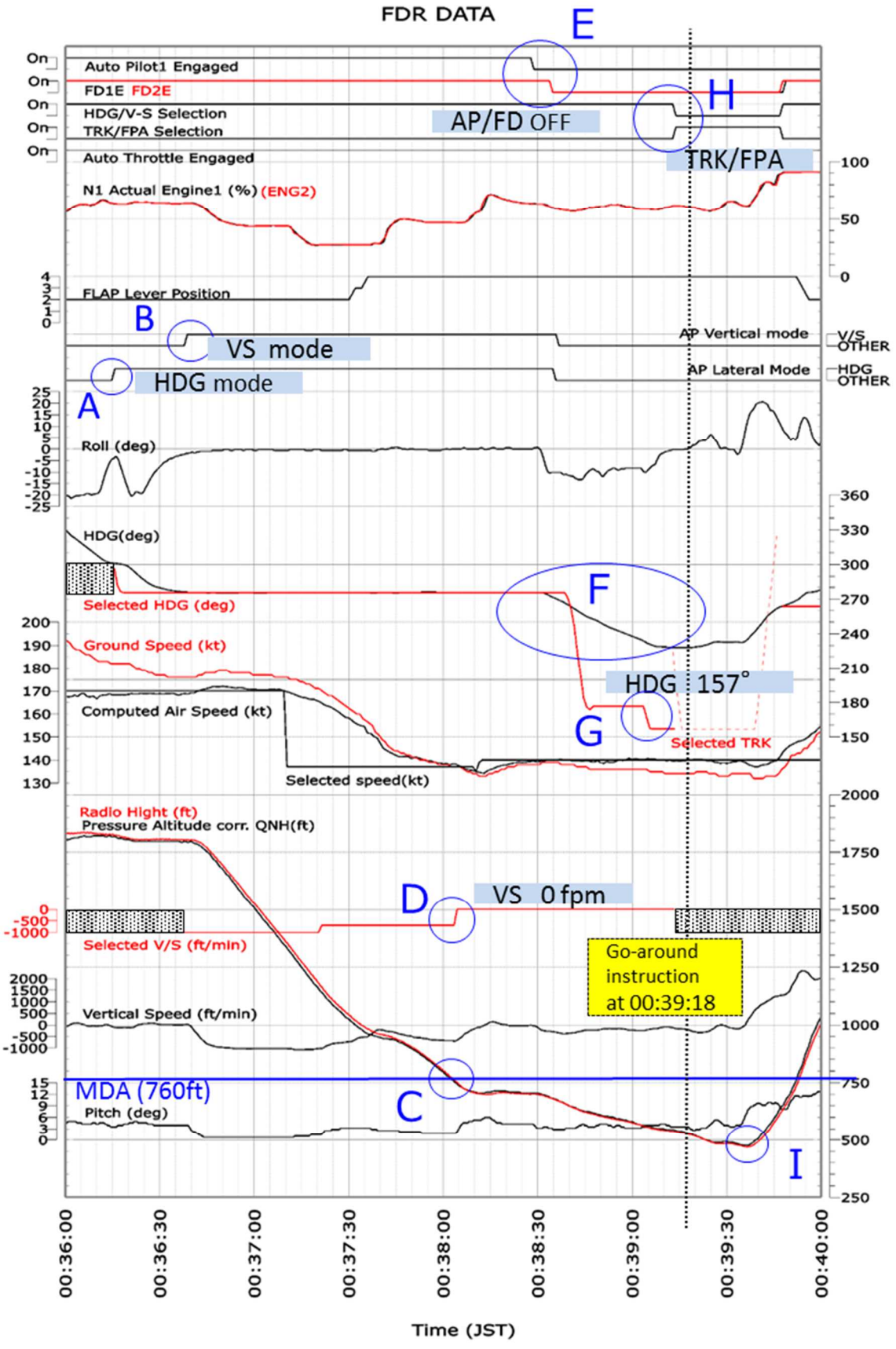


Appended Figure 4 Meteorological Information

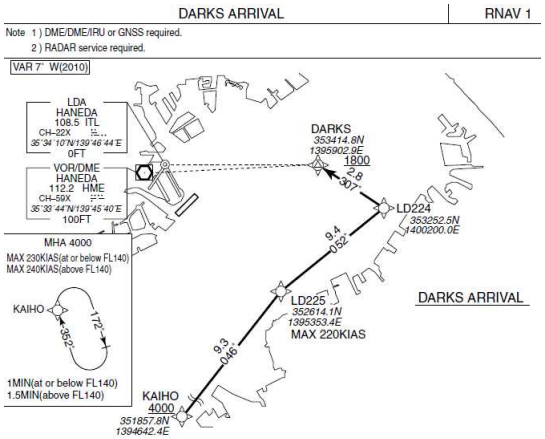


Asian Surface Weather Chart as of at 1200UTC on December 21, 2016

Appended Figure 5 FDR records

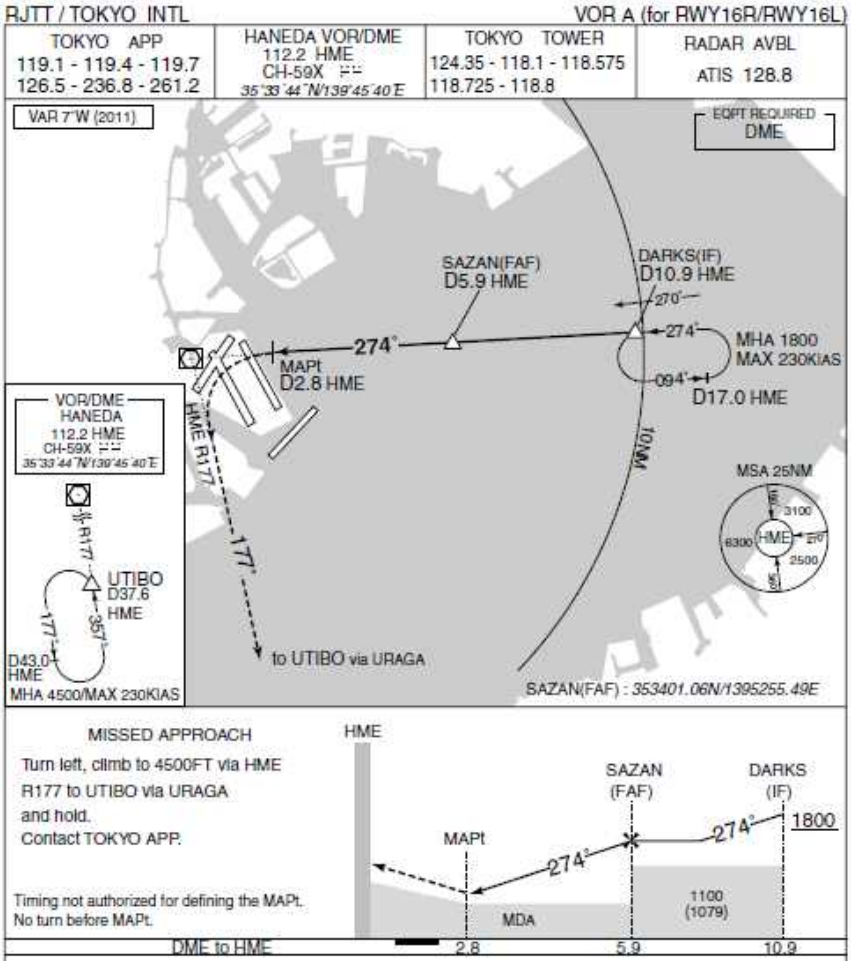


Appended Figure 6 DARKS arrival



Appended Figure 7 VOR A approach at HND

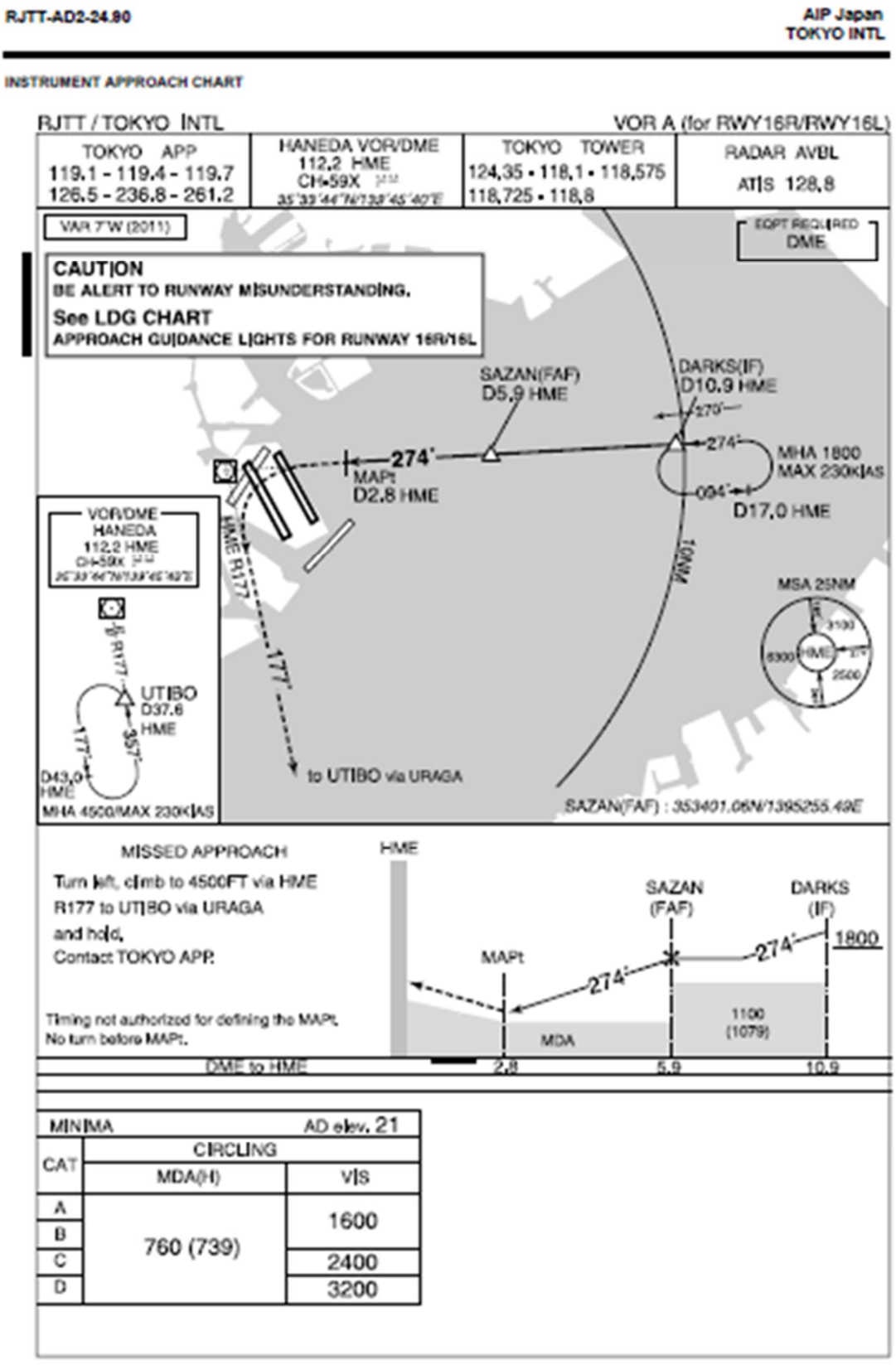
(At the time of the serious incident occurred)



MINIMA		AD elev. 21
CAT	CIRCLING	
	MDA(H)	VIS
A	760 (739)	1600
B		
C		2400
D		3200

Appended Figure 8 VOR A approach at HND

(Effective at December 07, 2017)



Appended Figure 9 Runway Closure Schedule and Operation Pattern At HND in Late-Night and Early-Morning Hours

Runway Closure Schedule and Operational Patterns

(from winter in 2016 to summer in 2017)

DAY	Closed RWY	Schedule of Closure (JST) 23:00 – 23:30 – 2:00 – 6:00
Mon	A	Pattern-1
	B	Pattern-1
Tue	B	Pattern-2 / Pattern-3
	C	Pattern-2 / Pattern-3
Wed	A	Pattern-4
	D	Pattern-4
Thu	A	Pattern-1
	B	Pattern-1
Fri	B	Pattern-2 / Pattern-3
	C	Pattern-2 / Pattern-3
Sat	A	Pattern-5 / Pattern-4
	D	Pattern-5 / Pattern-4
Sun	B	Pattern-2 / Pattern-3
	C	Pattern-2 / Pattern-3

◇This document should is used to refer to runway usage and approach procedures in late-night and early-morning hours.

◆ Order of priority about runway usage is published in AIP, in which order of priority for deaprting runway and order of priority for arriving aircraft are described separately.

◆However, handling departures and arrivals separately following order of priority decribed in AIP would create too inefficient situation. Thereore, in the actual operation, air traffic controllers select optimum combinations from those orders depending on traffic status.

◆There are some patterns of combinations based on runway closure schedule upon the day of the week, where actual weather condition might affect them.

◆Please paricularly note pattern-4 (P-4), which including an approach procedure rarely assigned.

◆Referring weather minima in each approach chart would promote your better understanding.

"N "stands for Northern Wind prevailing.
"S " stands for Southern Wind prevailing.
"Calm" indicates that wind velocity is less than 8 kt.
"Strong "indicates that wind velocity is more than 8 kt.
"Bad "indicates that weather is significantly bad.

Operational Pattern (App type & Using RWY)

P-1 RWY A & B closed = Use RWY C & D

Wind	APP TYPE	LDG RWY	DEP RWY
N (Strong)	ILS Y RWY34R	34R	05
N (Calm)	ILS Y RWY34R	34R	05
N (Bad)	ILS Y RWY34R	34R	05
S (Strong)	ILS Y RWY34R	34R	05
S (Calm)	LDA Y RWY23	23	16L
S (Bad)	ILS Y RWY23	23	16L

P-2 RWY B closed = Use RWY C & D

Wind	APP TYPE	LDG RWY	DEP RWY
N (Strong)	ILS Y RWY34R	34R	05
N (Calm)	ILS Y RWY34R	34R	05
N (Bad)	ILS Y RWY34R	34R	05
S (Strong)	ILS Y RWY34R	34R	05
S (Calm)	LDA Y RWY23	23	16L
S (Bad)	ILS Y RWY23	23	16L

P-3 RWY B & C closed = Use RWY A & D

Wind	APP TYPE	LDG RWY	DEP RWY
N (Strong)	ILS Y RWY34L	34L	05
N (Calm)	ILS Y RWY34L	34L	05
N (Bad)	ILS Y RWY34L	34L	05
S (Strong)	ILS Y RWY34L	34L	05
S (Calm)	LDA Y RWY23	23	16R
S (Bad)	ILS Y RWY23	23	16R

P-4 RWY A & D closed = Use RWY C

Wind	APP TYPE	LDG RWY	DEP RWY
N (Strong)	ILS Y RWY34R	34R	
N (Calm)	ILS Y RWY34R	34R	16L
	VOR A or VISUAL	16L	
N (Bad)	ILS Y RWY34R	34R	16L
S (Strong)	VOR A or VISUAL	16L	
S (Calm)	ILS Y RWY34R	34R	16L
	VOR A or VISUAL	16L	
S (Bad)	Open RWY D and follow P-5 pattern		

P-5 RWY A closed = Use RWY C & D

Wind	APP TYPE	LDG RWY	DEP RWY
N (Strong)	ILS Y RWY34R	34R	05
N (Calm)	ILS Y RWY34R	34R	05
N (Bad)	ILS Y RWY34R	34R	05
S (Strong)	LDA Y RWY23	23	16L
S (Calm)	ILS Y RWY34R	34R	05
S (Bad)	ILS Y RWY23	23	16L

Appended Figure 10 Three-View Drawing of Airbus A 320-214

Unit: m

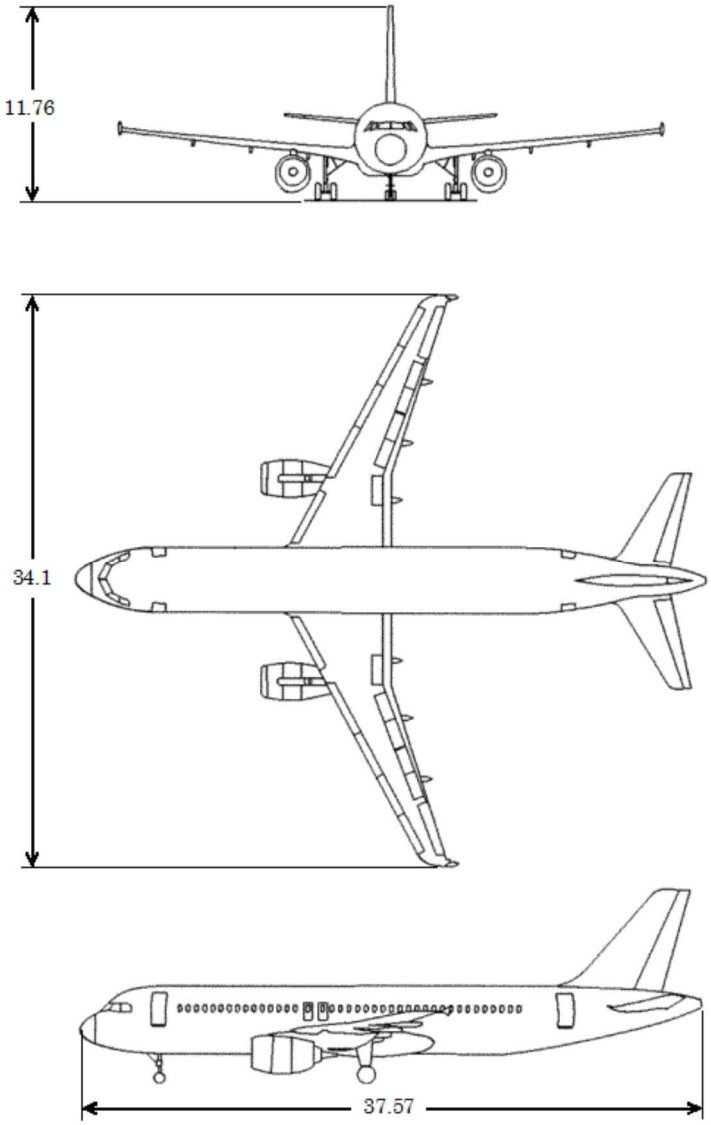


Photo 1 The Aircraft