

AI2015-1

**AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT**

**KOREAN AIR LINES CO., LTD.
H L 7 5 9 9**

January 29, 2015



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.

Norihiro Goto
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

RUNWAY OVERRUNNING
KOREAN AIR LINES CO., LTD.
BOEING 737-900, HL7599
ON RUNWAY 10 AT NIIGATA AIRPORT
AT 19:42, AUGUST 5, 2013

January 9, 2015

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Keiji Tanaka

SYNOPSIS

<Summary of the Serious Incident>

On Monday, August 5, 2013, a Boeing 737-900, registered HL7599, operated by Korean Air as the scheduled flight KAL 763, was unable to stop within the runway 10 in Niigata Airport after landing, and came to rest with the nose gear trespassing into the grass area of the easterly end of the runway at 19:42 Japan Standard Time.

A total of 115 persons on board, including a captain, eight crewmembers, and 106 passengers did not suffer any injuries.

<Probable Causes>

It is highly probable that this serious incident occurred when the Aircraft landed on runway 10 in Niigata Airport, the Captain did not let the Aircraft reduce enough lower speed to approach the runway threshold lights that the Captain understood as the stop bar lights for the intersecting runway 04/22, which the Captain was holding a doubt, and when the Captain realized there was no runway beyond the red lights, the Aircraft could not stop within the runway anymore, resulting in overrunning.

It is highly probable that the reasons why the Captain understood the runway threshold lights as the stop bar lights for the intersecting runway 04/22, and why the Captain did not let the Aircraft reduce enough lower speed to approach the lights, are as follows:

- (1) Both the Captain and the F/O presumed that the ATC instruction “cross runway 04/22” from the Niigata Tower was “the clearance to cross the intersecting runway during landing roll” rather than “the taxi clearance including crossing the intersecting runway after vacating the runway,” unable to understand the intention of the instruction, and both of them believed the Aircraft was short of the intersecting runway.
- (2) The Captain was going to roll to the end of the runway; therefore, he disarmed the autobrakes as fast as about 70 kt. After that the Captain could not take appropriate control of reducing speed with manual braking, even though he should have reduced speed in a careful manner.

It is also somewhat likely that the following reasons contributed to the occurrence of this serious incident:

- The Captain and the F/O were not familiar with Niigata Airport which had a intersecting runway, and they had difficulty to identify the intersecting position with runway 04/22 because ground objects and others which pilots could observe during night landing were limited. In such circumstances, it was difficult for them to judge the speed of the Aircraft in the low speed area in which they did not count on the airspeed indicator.

This report uses the following abbreviations:

ABV	: Above
ADJ	: Adjustment
AIP	: Aeronautical Information Publication
ALT	: Altitude
APP	: Approach
ATC	: Air Traffic Control
ATTN	: Attention
AVBL	: Available
BLW	: Below
CAPT	: Captain
CVR	: Cockpit Voice Recorder
DFDR	: Digital Flight Data Recorder
DIST	: Distance
ELEV	: Elevation
FCOM	: Flight Crew Operation Manual
FCTM	: Flight Crew Training Manual
FEW	: Few
FL	: Flight Level
FOM	: Flight Operations Manual
F/O	: First Officer
ISA	: International Standard Atmosphere
LDC	: Landing Distance Calculation
LDG	: Landing
LGT	: Light
MAC	: Mean Aerodynamic Chord
MLG	: Main Landing Gear
NLG	: Nose Landing Gear
NOTAM	: Notice To Airmen
PAPI	: Precision Approach Path Indicator
PF	: Pilot Flying
PIC	: Pilot in Command
PM	: Pilot Monitoring
POM	: Pilot Operating Manual
QRH	: Quick Reference Handbook
RA	: Radio Altitude
RCLL	: Runway Center Line Light(s)
REF	: Reference
REV	: Reverse
RMK	: Remark
RWY	: Runway
SCT	: Scattered
SPD	: Speed
TACAN	: UHF Tactical Air Navigation Aid

TEMP	: Temperature
TKOF	: Take-off
TWR	: Tower Controller
TWY	: Taxiway
UFN	: Until Further Notice
UHF	: Ultra High Frequency
U/S	: Unserviceable
VHF	: Very High Frequency
VOR	: VHF Ominidirectional Radio Range
VORTAC	: VOR and TACAN combination
VREF	: Reference Landing Speed
WT	: Weight

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. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Serious Incident

On Monday, August 5, 2013, a Boeing 737-900, registered HL7599, operated by Korean Air as the scheduled flight KAL 763, was unable to stop within the runway 10 in Niigata Airport after landing, and came to rest with the nose gear trespassing into the grass area of the easterly end of the runway at 19:42 Japan Standard Time.

A total of 115 persons on board, including a captain, eight crewmembers, and 106 passengers did not suffer any injuries.

1.2 Outline of the Serious Incident Investigation

The occurrence covered by this report falls under the category of “Overrun, undershoot and deviation from a runway (limited to when an aircraft is disabled to perform taxiing)” as stipulated in Clause 3, Article 166-4 of the Ordinance for Enforcement of the Civil Aeronautics Act of Japan, and is classified as a serious incident.

1.2.1 Investigation Organization

On August 5, 2013, the Japan Transport Safety Board designated an investigator-in-charge and two other investigators to investigate this serious incident.

1.2.2 Representatives and Advisor of the Relevant States

An accredited representative and an advisor of Republic of Korea, as the State of Registry and State of the Operator of the aircraft involved in this serious incident as well as an accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft, participated in the investigation.

1.2.3 Implementation of the Investigation

On-site investigation, interviews, and airframe examination

August 6 - 8, 2013

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

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

1.2.5 Comments from the Relevant States

Comments on the draft report were invited from the relevant States.

2. FACTUAL INFORMATION

2.1 History of the Flight

On August 5, 2013, a Boeing 737-900 (hereinafter referred to as “the Aircraft”), registered HL7599, operated by Korean Air (hereinafter referred to as “the Company”), as the scheduled flight 763 of the Company, took off from Incheon International Airport at 18:09 (Japan Standard Time and Korea Standard Time. The same hereinafter), approached runway 10 (hereinafter referred to as “RWY 10”) in Niigata Airport.

The flight plan of the Aircraft was as follows:

Flight rules:	Instrument flight rules
Departure aerodrome:	Incheon International Airport
Estimated off-block time:	18:00
Cruising speed:	461 kt
Cruising altitude:	FL 370
Route:	(omitted) - Y513 (RNAV route) - KMC (Komatsu VORTAC) – V30 (airway) - GTC (Niigata VORTAC)
Destination aerodrome:	Niigata Airport
Total estimated elapsed time:	1 h 46 min
Fuel load expressed in endurance:	4 h 37 min
Alternate aerodrome:	Narita International Airport

There were a total of 115 persons on board the Aircraft, including the Captain, eight crewmembers, and 106 passengers. The Captain sat in the left seat as the PF (pilot flying: pilot mainly in charge of flying), and the First Officer (hereinafter referred to as “the F/O”) sat in the right seat as the PM (pilot monitoring: pilot mainly in charge of monitoring) in the cockpit.

The history of the flight leading to this serious incident is summarized below, based on the records of the Digital Flight Data Recorder (hereinafter referred to as “the DFDR”), the records of the Cockpit Voice Recorder (hereinafter referred to as “the CVR”), the records of the air traffic communications, and the statements of crewmembers and others.

2.1.1 History of the Flight Based on the DFDR and the CVR Records, and the Records of Air Traffic Communications

- 19:37:36 The Aircraft made initial contact with the Aerodrome Control Tower of Niigata Airport (hereinafter referred to as “the Niigata Tower”). The Niigata Tower instructed the Aircraft to continue approach for RWY 10.
The Aircraft was descending around the altitude of about 2,900 ft with the airspeed of 194 kt and turned its heading to the final approach course.
- 19:38:27 The Niigata Tower issued a landing clearance for RWY 10 and informed that the wind was 040° and at 4 kt. The Aircraft read back the landing clearance.
- 19:39:42 The autopilot was disengaged around the altitude of 1,000 ft with the airspeed of 151 kt, and then the auto throttle was disconnected.
- 19:39:43 The automatic voice call-outs (hereinafter referred to as “Auto Callout”) of “One thousand” (1,000 ft radio altitude: hereinafter referred to as “RA”) was announced. The F/O called “Cleared to land”, and the Captain answered “Stabilized.”
- 19:39:58 An Auto Callout of “Minimum” was announced and the Captain replied

“Landing”.

19:40:11 An Auto Callout of “Five hundred” (500 ft RA) was announced and the Captain replied “Stabilized”. Auto Callouts at every 100 ft RA followed hereafter.

19:40:34 The Captain said “It's not to say that the center line lights are not available. It looks that those are available there”. (by Korean language mixed with English)

19:40:46 An Auto Callout of “Fifty” (50 ft RA) was announced. The Aircraft passed RWY 10 threshold at the airspeed of 150 kt. Auto Callouts at every 10 ft RA followed hereafter.

19:40:52 When the Aircraft touched down on RWY 10 with the main landing gears at the airspeed of 143 kt, the maximum vertical acceleration value was 1.34 G.
The speed brakes (spoilers) automatically started to extend.

19:40:54 As the brake pressure on the main wheels was rising, the deceleration rate started to increase (the longitudinal acceleration started to decrease). Thrust levers were raised up to reverse.

19:40:55 The F/O called “Speed brakes up” (Spoilers were deployed), and the Captain answered “Check”. Thrust reversers started to deploy.

19:40:57 Thrust reversers were fully deployed, and the thrust levers were raised up to maximum reverse position.

19:40:59 The F/O called “Two reverse green” (Both thrust reversers were normally operated).
Nose landing gear of the Aircraft lowered to the runway.

19:41:06 The Captain asserted “We are going to roll to the end of runway”. (by Korean language mixed with English), and the F/O answered “It would be better that we are going to the end of runway” (same).

19:41:09 When the F/O called “Eighty” (airspeed of 80 kt), the airspeed was about 88 kt.

19:41:11 The Captain called “Reverse idle.”

19:41:12 Thrust levers started to gradually retard from the full reverse position at the airspeed of 80 kt.

19:41:15 Thrust levers were positioned to the reverse idle at the airspeed of 74 kt.

19:41:16 The speed brake lever started to stow and the spoilers started to be retracted at the airspeed of 73 kt.
The Niigata Tower instructed to the Aircraft, “Korean Air seven-six-three (KAL763), turn right end of runway Bravo One (B1) and taxi to spot cross runway zero-four/two-two(04/22),” which was the instruction of exit taxiway and the clearance of taxi.

19:41:17 The spoilers were completely retracted at the airspeed of 69 kt. The brake pressure on the main wheels dropped and the deceleration rate rapidly decreased.

19:41:23 When the Aircraft read back to the Niigata Tower, “Cross runway 04/22, end of runway right turn,” the airspeed was 64 kt.

19:41:25 The brake pressure on the main wheels started to rise at the airspeed of 62 kt, and the deceleration rate gradually started to increase.

19:41:28 The Captain noted “Cross runway 04/22,” and the F/O wondered “Cross runway?”

19:41:29 The brake pressure on the main wheels rapidly rose at the airspeed of 56 kt, and the deceleration rate also increased along with it.

19:41:34 After the vertical acceleration and the longitudinal acceleration fluctuated, the

pitch angle started to decrease.

19:41:37 The longitudinal acceleration drastically changed and the Aircraft halted with the pitch angle of about -4° and the magnetic heading of about 100°.

19:41:40 The Captain ordered “Shut down.” The engines came to stop and the DFDR terminated its recording .

According to the records of the CVR after shutdown of the engines, the dialogue between the Captain and the F/O (by Korean language mixed with English) included the following contents.

- Because the Captain and the F/O assumed that the red lights might be the stop bar lights for the intersecting runway 04/22 (hereinafter referred to as “RWY 04/22”), they tried to continue to proceed beyond those lights.
- The Captain and the F/O could not accurately recognize where the taxiways and intersecting RWY 04/22 were located.
- The Captain and the F/O did not see the runway distance marker lights.
- The Captain thought that he should have reduced speed earlier.
- The Captain disarmed the Auto Brake by stowing the speed brake (spoiler) lever.
- Since the Captain intended to continue rolling to the end of the runway, the Captain were going to reduce speed slowly after the autobrakes were disarmed.

2.1.2 Statements of Crewmembers and the Air Traffic Controller

(1) Captain

KAL 763 took off from Incheon International Airport at 18:09 and continued flying smoothly. Approximately 45-50 minutes before landing, the Captain began the approach and the landing briefing with the F/O following their landing preparation. The Captain confirmed in NOTAM that the runway centerline lights for RWY 10/28 in Niigata Airport were partially out of service. The Captain knew that upon vacating RWY 10 they could not use RWY 04/22 because the Company Notice (later described in 2.10.2) alerted not to have RWY 04/22 confused with taxiway (hereinafter referred to as “TWY”) P3 and B1 while vacating RWY 10. Since the Aircraft was heavy with the landing weight of about 136,000 lb (about 61,700 kg) because of extra fuel on board, the Captain intended to let the Aircraft roll out to the end of RWY 10 and vacate from TWY-B1 at there. The Captain had confirmed the landing distance of about 7,000 ft (about 2,130 m) with Flap-30 (Flap-40 might be used in a tailwind condition but Flap-30 if not) and Autobrake-2. He had finished all preparations at the time of 40 minutes before landing.

According to the information at 19:06, the wind was 050° and at 6 kt and the visibility was 20 km at Niigata Airport. The Aircraft was cleared for VOR RWY 10 approach.

The Captain had lowered the landing gears at around 10 nm on final, up to where he had used the speed brakes to reduce its speed against the tail wind. The Captain had already set Flap-30 prior to AIBIS (the point of 5.0 nm from RWY 10 threshold), which is the final approach fix. According to the precision approach path indicator (hereinafter referred to as “PAPI”), the Aircraft was flying with a little higher descent path while passing 1,500 ft and 1,000 ft. The Captain disengaged the autopilot and auto throttle at the altitude of about 1,000 ft during descent and noticed that PAPI showed flying with a slightly lower descent path at about 500 ft RA. Because PAPI of RWY 10 in Niigata Airport is placed at 1,775 ft (541 m) from RWY 10 approach end, which located farther than the typical distance, the Captain planned to

consciously fly with a slightly lower path in a conscious manner not to let the Aircraft result in a long touchdown.

The 737-900 model becomes heavier due to the extended airframe, which caused its prescribed approach speed to fly faster among the 737 series. The Aircraft approached generally at the target speed of 151 kt, which was added 5 kt to the VREF of 146 kt.

The Captain initiated a flare at about 30 ft RA and firmly landed around the slightly fore area of abeam PAPI. The Captain checked the F/O's call of "Speed brakes up," then another call "Two reverse green" was followed by the operation of thrust reversers and the Captain let the nose landing gear touch to the runway. The Captain thought that the runway centerline lights which were described as partially out of service in NOTAM were all visible. The Captain made the Thrust Reverse lever slowly retard while the Aircraft was passing by TWY-B2 and he switched to manual brakes from the autobrakes. Although the Captain heard the F/O's call of "Eighty", he did not hear the call of "Sixty" (airspeed 60 kt). The Captain intended to vacate from TWY-B1 as he briefed.

The Captain remembered that the Niigata Tower intended to instruct them somewhat like "crossing runway 04/22 and vacate via B1," but the Captain did not understand the meaning of "cross runway 04/22."

The Captain was reviewing about the following fact:

- They got the landing clearance, in which they are allowed to use the entire runway; however, the tower instructed them to cross RWY 04/22.
- They were not allowed to proceed into RWY 04/22 and they were able to vacate from only TWY-P3 or TWY-B1.
- The Captain thought that they had not yet passed TWY-P3 or RWY 04/22 because he could not find the signs for TWY-P3 or RWY 04/22.
- The Captain saw the bright red lights in a horizontally straight line.

These were why the Captain assumed that there were stop bar lights in short of RWY 04/22.

The Captain stated that what he thought to be stop bar lights for RWY 04/22 were actually the runway threshold lights.

When the Captain proceeded to the red lights in a horizontally straight line following the instruction by the Niigata tower (cross runway 04/22), he noticed that there was no more runway beyond the lights and applied the full brake. However, they had only short runway left available and the nose gear of the Aircraft overshot and trespassed in the grass, eventually the Aircraft halted with the main gears stayed in the pavement area. The Captain immediately shut down both engines and started the auxiliary power unit.

The Captain normally judges the runway remaining distance with using runway centerline lights, which varies in color according to distance. The Captain was normally making a point of vacating a runway in following manner as a guide:

- the speed should be less than 80 kt where runway centerline lights change from straight white to alternate red and white: the remaining distance is about 3,000 ft (about 910 m),
- the speed should be less than 50 kt where the remaining distance is about 2,000 ft (about 610 m),
- the speed should be around somewhat 10 kt where the lights change from alternate red and white to straight red: the remaining distance of about 1,000 ft (about 300 m).

The Captain could not notice the changes in the color of the runway centerline lights at this time, possibly because he was concentrating on the red lights in a horizontally straight line.

Although the Captain used to come to Niigata Airport three or four times a year, he had never come last year. The Captain had landed on both RWY 10 and RWY28, and it was not to say that the Captain experienced VOR RWY 10 approach for the first time; besides, the Captain also had landed on Niigata Airport at night.

The Aircraft had no anomaly and every systems had normally worked.

The Captain had three days off before this flight.

(2) F/O

In the landing briefing, the Captain and the F/O confirmed that the landing distance of about 7,000 ft (about 2,130 m) maintained a margin of more than 1000 ft (about 300 m) against 8,200 ft (2,500 m): the length of RWY 10/28 in Niigata Airport. The Captain selected Flap-30 and Autobrake-2 with the intention of vacating from TWY-B1. The Aircraft captured the final approach course near the AIBIS, and they received the landing clearance from the Niigata Tower.

Upon an Auto Callout of “One thousand,” the F/O called “Cleared to land” to ensure the landing clearance and the Captain answered “Stabilized”. The Captain had already disengaged the autopilot at that time.

The approach path was slightly high at first, though, it turned to be slightly lower in PAPI indication and was maintained following the Captain’s correcting. The target speed was 151 kt and the actual speed might have been faster by 1 to 2 kt than it but never became below it, the approach was extremely stable. Immediately after passing the runway threshold, the F/O heard the Auto Callout of “Fifty”. Flare was initiated, and the Aircraft landed around the slightly fore area of abeam PAPI.

After the F/O called out “Speed brakes up,” “Two reverse green” with monitoring instruments, the F/O was shifting to carefully watch outside to get the position where they were rolling. The F/O was able to see the three rows of taxiway edge light sets in blue color on his right side, which the F/O presumed to be TWY-B2, P3, and B1. Since the F/O thought that the Aircraft was too fast to vacate from TWY-P3, the F/O advised the Captain to vacate from TWY-B1 as scheduled.

The F/O remembers that the Niigata Tower instructed them, it is not sure for the F/O, but somewhat like “Clear crossing runway 04/22 and vacate end of runway via B1,” which the F/O assumed to be the approval instruction for them approaching the intersecting RWY 04/22 to cross it. The F/O, at this time, had already noticed that the Aircraft was getting closer to the red lights; however, the F/O wonder if those were the runway threshold lights for RWY 10 or the stop bar lights for RWY 04/22, In any case, the F/O regarded that the Aircraft was slightly too fast to stop short of the red lights. Since the red lights in a horizontal line were coming closer and closer to them, the F/O applied the brake together.

The F/O had ever come to Niigata Airport about seven or eight times, though, mostly RWY 28 was in used. It was the first time for the F/O to land on RWY 10 at night.

(3) Chief Purser

There was no special anomaly after landing, the chief purser felt harsh and abrupt braking force twice. After the Aircraft completely stopped, they had lost electric power in the cabin. When the Captain instructed that the flight attendants should remain seated, the chief purser apprehended that they were in an imminent situation. The electric power in the cabin was restored in about 10 through 20 seconds.

The chief purser made cabin announcement of their current situation, following the Captain’s briefing about the Aircraft.

(4) Air Traffic Controller in the Niigata Tower

RWY 10 was being used at this time. The wind was 040° and at 4 through 5 kt, and visibility was 20 km. No rain was observed and the runway was dry.

When the Aircraft approaching in 10 nm of Niigata Airport called the Niigata Tower, the Air Traffic Controller (hereinafter referred to as “the Controller”) in the Niigata Tower soon cleared the Aircraft to land as there was no other landing traffics except the Aircraft, and instructed the departing aircraft to hold on TWY-B5, which was expected to be cleared for taking off after the Aircraft landed.

The Controller instructed the departing aircraft to line up and wait after the Aircraft touched down near the touchdown zone as usual. A Boeing 737-900 commonly vacate from the runway end due to their fast rolling speed. Since the Controller, at that time, thought that the Aircraft seemed to be fast and unable to vacate from TWY-P3, the Controller instructed “Turn right end of runway B1, taxi to spot cross runway 04/22” when the Aircraft was passing around TWY-P3. The Controller thought that they read back correctly. He did not feel any unusual tone in their reading back voice.

The Controller had been instructed to use the phrase of “Turn right end of runway” since they had got trained as an air traffic controller in the Niigata Airport. The air traffic controller has usually instructed “Turn right end of runway B1 and taxi to spot cross runway 04/22” in order that the air traffic controller could alert the involving traffic to wrongly enter RWY 04/22 and raise awareness of not proceeding further beyond TWY-B1. RWY 04/22, compressive strength of the runway surface was supposed to be used only for the aircraft within certain of weight, though, in the past, a large airplane which landed on RWY 10 had entered RWY 04/22 by mistake.

Since the Controller could not realize how the Aircraft overran, the Controller asked an aeronautical information officer to be dispatched and confirm the situation of the Aircraft. The aeronautical information officer reported that the nose landing gear of the Aircraft was entirely overrun into the grass, and then some fire engines were deployed from the airport fire department by his information.

The Controller declared to close the runway, judging that the runway could not be resumed in service immediately.

This serious incident occurred around the east side of the end of RWY 10 at Niigata Airport (latitude 37°57' 21” north and longitude 139°07' 27” east) at 19:42, on August 5, 2013.

(See Figure 1: Estimated Landing Roll Diagram, Figure 3: Lights and others around the End of RWY 10, Figure 4: Actual Lighting Status on RWY 10 at the Occurrence of the Serious Incident, Figure 5: DFDR Records, Photo 1: Serious Incident Aircraft, Photo 2: Serious Incident Site, Attachment: Records of ATC Communications)

2.2 Damage to the Aircraft

None

2.3 Other Damage

- Three approach lights were damaged
- One overrun light was damaged

2.4 Personnel Information

2.4.1 Flight Crewmembers

(1) Captain	Male, Age 44	
Airline transport pilot certificate (Airplane)		February 28, 2011
Type rating for Boeing 737		July 19, 2002
Class 1 aviation medical certificate		
Validity		April 30, 2014
Total flight time		7,105 h 28 min
Flight time in the last 30 days		63 h 41 min
Total flight time on the type of aircraft		2,629 h 33 min
Flight time in the last 30 days		63 h 41 min
(2) First Officer	Male, Age 45	
Airline transport pilot certificate (Airplane)		December 27, 2011
Type rating for Boeing 737		April 13, 2009
Class 1 aviation medical certificate		
Validity		January 31, 2014
Total flight time		4,641 h 23 min
Flight time in the last 30 days		62 h 42 min
Total flight time on the type of aircraft		1,860 h 07 min
Flight time in the last 30 days		62 h 42 min

2.4.2 Air Traffic Controller

Air traffic controller on the duty of the Niigata Tower	Male, Age 58	
Air Traffic Controller Qualification Certificate		
Aerodrome control services		October 1, 1979
Medical Certificate		
Validity		June 30, 2014
Aviation English Language Proficiency Certificate		
Validity		March 31, 2015

2.5 Aircraft Information

2.5.1 Aircraft

Type		Boeing 737-900
Serial number		29988
Date of manufacture		November 13, 2001
Certificate of airworthiness		AB0940
Validity or Expiration date		From September 25, 2012, to when the certificate of airworthiness becomes discontinued or suspended
Category of airworthiness		Airplane, Transport T
Total flight time		21,548 h 00 min
Flight time since last periodical check (A check on July 20, 2013)		92 h 58 min
(See Figure 2: Three Angle View of Boeing 737-900)		

2.5.2 Weight and Balance

When the serious incident occurred, the Aircraft's weight and the position of the center of gravity are estimated to have been about 134,500 lb and 25.4 % mean aerodynamic chord (MAC),

respectively, within the allowable range (maximum landing weight of 146,300 lb, and 6.0 to 36.0 % MAC corresponding to the weight at the time of the serious incident).

2.5.3 Situation of the Aircraft

Upon checking the general external condition of the Aircraft, no damage was found on the aircraft, both main and nose landing gears (including the wheels and tires). The depth of tire grooves and the remaining brake pad amount were all within the allowable limits. Self-diagnosis for the anti-skid/auto brake control units was conducted, but no fault was found. Moreover, the thrust reverser operation check was conducted, but no anomaly was found.

When the fault occurrence history on the Aircraft system was checked, it was “NO FAULT.”

2.6 Meteorological Information

The aviation weather observations at Niigata Airport around the time of the Aircraft landing were as follows:

19:00 Wind direction: 050°, Wind velocity: 6 kt, Prevailing visibility: 20 km,
Clouds: Amount FEW*¹, Type Cumulus, Cloud base 3,000 ft
Amount SCT*², Type Cumulus, Cloud base 8,000 ft
Temperature: 26°C, Dew point: 24°C
Altimeter setting (QNH): 29.69 inHg

20:00 Wind direction: 040°, Wind velocity: 5 kt, Prevailing visibility: 20 km,
Clouds: Amount FEW, Type Cumulus, Cloud base 3,000 ft
Amount SCT, Type Cumulus, Cloud base 8,000 ft
Temperature: 25°C, Dew point 24°C
Altimeter setting (QNH): 29.69 inHg

In Niigata Airport, anemometers are placed near each touchdown zone on RWY 10/28. The average wind direction and wind velocity in the past 10 minutes according to the records of each anemometer during the time period when the Aircraft landed were about 040° and 3 to 4 kt. No major fluctuation was observed.

In addition, no rain was observed in Niigata Airport on the day of this serious incident.

2.7 Information on DFDR and CVR

The Aircraft was equipped with a DFDR (part number 980-4700-042) and a CVR (part number: 980-6022-001) manufactured by Honeywell of the United States of America, and records concerning this serious incident were retained in both recorders.

The time calibration for DFDR and CVR was conducted by comparing the time signals recorded in the air traffic control communication records with the VHF keying signals recorded in DFDR and air traffic control communications recorded in CVR.

2.8 Serious Incident Site Information

2.8.1 Runways and others in Niigata Airport

The aerodrome reference point elevation of Niigata Airport is 4.6 ft. The airport has two runways, including RWY 10/28 that is 2,500 m long and 45 m wide and RWY 04/22 that is 1,314 m long and

*1 FEW refers to cloud amount 1/8 - 2/8.

*2 SCT refers to cloud amount 3/8 - 4/8.

45 m wide. The PAPI angle on RWY 10 is 3°, and it is placed on the left side of the runway 541 m from the threshold. As the below figure shows, RWY 10 holds a down slope of 0.21 % in an average between the threshold and the end.

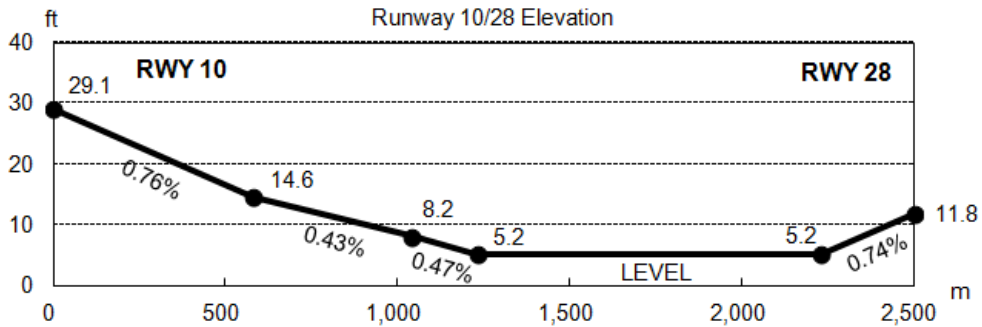


Figure A: Slope of RWY 10/28 (Prepared with AIP information)

The main landing gears of the Aircraft were stayed at the stopway of about 58 m beyond the end of RWY 10, and the nose landing gear came to rest at the spot of about 75 m beyond the end of RWY 10 where was in the grass area. Tire marks in a light color of the main landing gear wheels were found in patches on the runway and the stopway for about 220 m (about 160 m on the runway). One stopway light and three approach lights for RWY 28 were damaged by hitting of the Aircraft wheels.

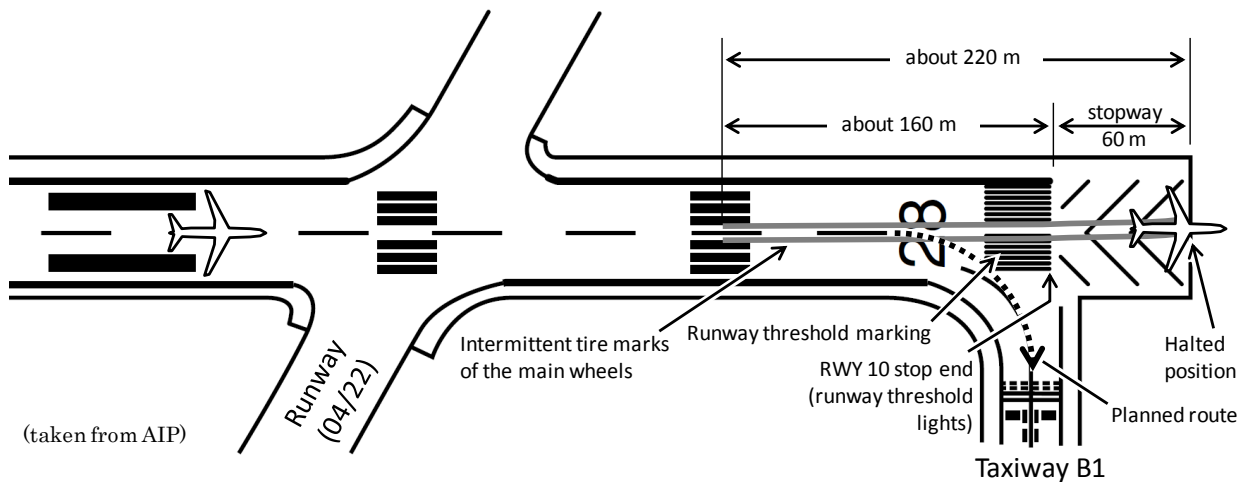


Figure B: Marks left on the runway

Since the Aircraft was classified as an overloaded group about compressive strength of RWY 04/22 (having adverse effect on the pavement), the Aircraft cannot enter RWY 04/22 without an approval.

Operating time of Niigata Airport is from 7:30 to 20:30. The runway was closed for 11 h 46 min from 19:44, which was immediately after the serious incident, to 07:30 (operating start time) of the following day.

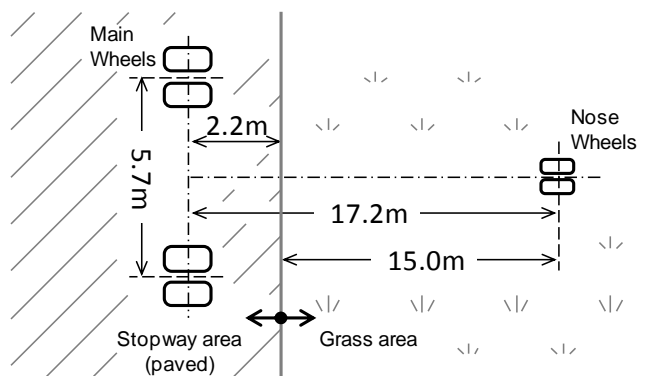


Figure C: Gear positions

(See Figure 1: Estimated Landing Roll Diagram, Photo 1: Serious Incident Aircraft, Photo 2: Serious Incident Site)

2.8.2 Air Navigation Facilities

(1) Aeronautical Lights

Runway distance marker lights, which indicate the remaining distance of the runway, are placed about every 1,000 ft (about 300 m) on both sides of RWY 10/28 in Niigata Airport. When aircraft lands on RWY 10, the positions with the remaining distance of 2,000 ft and 1,000 ft are the intersecting positions of TWY-P3 and RWY 04/22 respectively. Therefore, runway distance marker lights are not placed on the right side of the runway (terminal building side).

The runway centerline lights are red lights within the 300 m range before the end of the runway, and alternate red and white lights within the range 300 m to 900 m before the end of the runway. For other areas, they are white lights. Changes in the light colors inform flight crewmembers of the remaining runway distance.

In addition, the runway edge lights are yellow lights within the 600m range from the end of the runway, white lights for other areas. Changes in these light colors also inform flight crewmembers of the remaining runway distance. High intensity runway edge lights are placed on both of the two runways in Niigata Airport. Regarding the runway edge lights for RWY 04/22, over-the-ground type lamp units visible from all angles and directions up to 15° above the horizontal plane are used instead of inset type, the view of which is limited.

Along with RWY 10/28, the taxiway guidance lights indicating direction, route, intersection and such are properly installed on the TWY-B1 through B5 and TWY-P3, however, no sign boards are installed at the intersection point of RWY 10/28 with RWY 04/22, since the installation of the sign board and any lightings to indicate the crossing point of both runways is not mandated.

Taxiway edge lights are the blue lights that indicate edge of taxiways and apron.

Stop bar lights are the red lights installed on taxiways in the location to temporarily halt on a straight line crossing at right angle with the taxiway centerline. In Niigata Airport, they are placed on TWY-B1 to B5 and P3. They are activated/ deactivated when aircraft taxi from a taxiway to a runway with poor visibility. Stop bar lights do not exist on a runway.

According to the AIP-Supplements NR071/13 “Operating restrictions in Niigata Airport” dated June 27, 2013, it was notified that operations of Niigata Airport would be restricted from the beginning of July to the end of November of 2013 due to the construction works. It indicated that Runway Centerline Lights for RWY 10/28 would be out of service (with some activation) and that part of the taxiway centerline lights for TWY-B5 would be out of service. The place where these lights were out of service was the section of up to 200 meters from the RWY 10 threshold (approach end) and it was illustrated. It also described that the exact time and date and changes in the scheduled period would be notified by NOTAM.

At the time of this serious incident, the NOTAM indicating that part of the runway centerline lights for RWY 10/28 and part of taxiway centerline lights for TWY-B5 were out of service was valid (as below). Runway Centerline Lights for about 200 m on the threshold (approach end) of RWY 10 and part of the taxiway centerline lights for TWY-B5 were out of service, however, all other aeronautical lights had worked in a normal manner.

- RJSN 1217/13: RCLL FOR RWY 10/28-PARTLY U/S.
RMK/RCLL NOT AVBL FOR RWY 10/28 TKOF/LDG
- RJSN 1219/13: TWY-CENTERLINE-LGT FOR TWY B5-PARTLY U/S.
RMK/AVBL STOP BAR LGT

(NOTAM description)

- Niigata Airport, 2013 NOTAM number 1217: Part of Runway Centerline Lights for RWY 10/28 are out of service. Note: Runway Centerline Lights are unavailable when taking off from/landing to RWY 10/28
- Niigata Airport, 2013 NOTAM number 1219: Part of the taxiway centerline lights for TWY-B5 are out of service. Note: Stop bar lights are available.

(See Figure 3: Lights and others around the End of RWY 10, Figure 4: Actual Lighting Status on RWY 10 at the Occurrence of the Serious Incident, Photo 1: Serious Incident Aircraft, Photo 2: Serious Incident Site)

(2) Radio Air Navigation Facilities

There was no record of faults in radio air navigation facilities, such as VORTAC and other radio facilities placed in this airport at the time of this serious incident.

2.9 Information Regarding the Outbreak of Fire and Fire-Fighting Operation

At 19:43, the airport fire department received a call from an aeronautical information officer for a possible overrun event, and directed the officers and firefighters to be prepared for the first class service: required for readiness. Three fire engines were deployed and held on TWY-B1.

At 22:02, while one fire engine remained at the site, and the other fire engines returned to the station.

At 02:58, the operation to draw the Aircraft up had finished. The fire engine followed the Aircraft in attendance to the parking spot.

At 03:53, the alert was all cleared.

2.10 Additional Information

2.10.1 Estimated rate of descent

The rate of descent estimated with the radio altitude differences and the time intervals according to the DFDR records is as follows:

Radio altitude	Rate of descent
1,000 – 500 ft	about 1,090 ft/min
500 – 50 ft	about 770 ft/min

2.10.2 NOTAM Information of the Company

NOTAM information involving the flight 763 that the Captain and the F/O acquired from the Company before the departure contained the following information. (excerpt)

■ *COMPANY ADVISORY*

1. *17SEP08 07:00 – UFN*

** ATTN CREW **

DO NOT CONFUSE RWY04/22 WITH P3 OR B1, USE TWY P3 OR B1

ONLY WHEN EXIT RWY10

2.10.3 Regulations of the Company

(1) Landing Roll Procedure and Callout

“5. NORMAL OPERATIONS – APPROACH AND LANDING” in the Pilot Operating Manual (hereinafter referred to as “POM”) of the Company includes the following description : (excerpt)

Landing Roll Procedure / Callout

<i>PF</i>	<i>PM</i>
<i>Ensure that thrust levers are at idle.</i>	
(omitted)	(omitted)
<i>Verify that the SPEED BRAKE lever is UP.</i>	<i>Verify that the SPEED BRAKE lever is UP.</i> <i>Call out "SPEED BRAKES UP."</i> (omitted)
<i>Without delay, fly the nose wheel smoothly onto the runway.</i>	<i>Monitor the rollout progress.</i>
<i>Monitor the rollout progress</i>	
<i>Verify correct autobrake operation.</i>	
WARNING	
<i>After the reverse thrust levers are moved, a full stop landing must be made. (omitted)</i>	
<i>Without delay, move the reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Then apply reverse thrust as needed.</i>	<i>Monitor engine instruments and announce any engine limit being approached, exceeded or any other abnormalities.</i> <i>Verify development of engine reverse and call "TWO REVERSE GREEN."</i> (omitted)
<i>Maintain reverse thrust as required, up to maximum, until the airspeed approaches 80 knots. At this point, start reducing the reverse thrust so that the reverse thrust levers are moving down at a rate commensurate with the deceleration rate of the airplane. The thrust levers should be positioned to reverse idle by taxi speed, then to full down after the engines have decelerated to idle.</i>	<i>Call "80 KNOTS"</i> <i>"60 KNOTS"</i> (omitted) <i>Verify REV indication extinguished.</i>
<i>Note: A pause of approximately 18 seconds engages the electro-mechanical lock and prevents the thrust reverser sleeves from further movement. (omitted)</i>	

<i>Before taxi speed, disarm the autobrakes. Use manual braking as needed.</i>	<i>When AUTOBRAKE DISARM light illuminates, call "AUTO BRAKE DISARMED"</i>
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- *Runway vacating speed*
 - (omitted)
 - *Do not use nose wheel steering until reaching the taxi speed.*

(2) Operation procedures after landing

“5. NORMAL OPERATIONS – AFTER LANDING” in the POM of the Company includes the following description : (omitted)

Start the After Landing Procedure when clear of the active runway.

(omitted)

<i>CAPT</i>	<i>F/O</i>
<i>The captain moves or verifies that the SPEED BRAKE lever is DOWN.</i>	
(Following parts are omitted)	

(3) Using spoilers and reversers

“NORMAL OPERATIONS – Landing” in the Flight Operations Manual (hereinafter referred to as “FOM”) of the Company includes the following description : (excerpt)

Use of Spoilers and Reversers

- (omitted)
- *Do not use max reverse thrusts below 80 knots except for emergencies.*
- *Idle reverse may be used down to taxi speeds when necessary.*
- *The reversers should be in the stowed position while vacating the runway.*

(4) Vacating from a runway after landing

“NORMAL OPERATIONS – After Landing” in the FOM of the Company includes the following description: (excerpt)

Vacating Runway

The aircraft speed shall be reduced to an appropriate safe taxi speed before vacating a runway. (Following is omitted)

(5) Landing distance

“Performance Inflight – Advisory Information” in the Flight Crew Operation Manual (hereinafter referred to as “FCOM”) in the Quick Reference Handbook (hereinafter referred to as “QRH”) of the Company includes the following description: (excerpt)

However, the item “REVERSE THRUST ADJ (ONE REV / NO REV)” has been omitted due to the fact that reverse thrust of both engines was used in this case, requiring no correction.

Normal Configuration Landing Distances

	<i>LANDING DISTANCE AND ADJUSTMENT (FT)</i>									
	<i>REF DIST</i>	<i>WT ADJ</i>	<i>ALT ADJ</i>	<i>WIND ADJ PER 10 KTS</i>		<i>SLOPE ADJ PER 1%</i>		<i>TEMP ADJ PER 10°C</i>		<i>APP SPD ADJ</i>
<i>BRAKING CONFIGURATION</i>	<i>130000LB LANDING WEIGHT</i>	<i>PER 10000LB ABOVE/BELOW 130000LB</i>	<i>PER 1000FT ABOVE SEA LEVEL</i>	<i>HEAD WIND</i>	<i>TAIL WIND</i>	<i>DOWN HILL</i>	<i>UP HILL</i>	<i>ABV ISA</i>	<i>BLW ISA</i>	<i>PER 10KTS ABOVE VREF</i>

Flap 30

Dry Runway

<i>AUTOBRAKE 3</i>	<i>5430</i>	<i>330/-330</i>	<i>150</i>	<i>-230</i>	<i>790</i>	<i>10</i>	<i>-10</i>	<i>150</i>	<i>-150</i>	<i>560</i>
<i>AUTOBRAKE 2</i>	<i>6910</i>	<i>450/-450</i>	<i>210</i>	<i>-320</i>	<i>1080</i>	<i>140</i>	<i>-150</i>	<i>190</i>	<i>-190</i>	<i>520</i>

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust. Max manual braking data valid for auto speedbrakes. Autobrake data valid for both auto and manual speedbrakes. For max manual braking and manual speedbrakes, increase reference landing distance by 190 ft.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

Calculation of the landing distance under the conditions at the time of this incident with a dry runway in case of auto brake setting of 3 is as follows, using the table.

	<i>In this case</i>	<i>In case of autobrake-3</i>
<i>Auto brake</i>	<i>2</i>	<i>3</i>
<i>Flap</i>	<i>30</i>	<i>30</i>
<i>• REF DIST (reference distance) :</i>	<i>6,910</i>	<i>5,430</i>
<i>• WT ADJ (weight adjustment) (*1) :</i>	<i>270</i>	<i>198</i>
<i>• ALT ADJ (altitude adjustment) (*2) :</i>	<i>6</i>	<i>4</i>
<i>• WIND ADJ (wind adjustment) (*3) :</i>	<i>-80</i>	<i>-58</i>
<i>• SLOPE ADJ (slope adjustment) (*4) :</i>	<i>29</i>	<i>2</i>
<i>• TEMP ADJ (temperature adjustment) (*5) :</i>	<i>209</i>	<i>165</i>
<i>• APP SPD ADJ (approach speed adjustment) (*6) :</i>	<i>208</i>	<i>224 (*7)</i>
	<i>7,552 ft</i>	<i>5,965 ft</i>
	<i>(2,302 m)</i>	<i>(1,818 m)</i>

(*1) : Calculated with the landing weight of 136,000 lb used by the Captain and the F/O

(*2) : Calculated with the highest altitude of 29.1 ft on RWY 10

(*3) : Calculated with the head wind of 2.5 kt according to the observed values
(wind 040° at 5 kt) at 20:00

(*4) : Calculated with the average down slope of 0.21 % on RWY 10

(*5) : Calculated with the temperature of 26°C at 19:00

(*6) : Calculated with the airspeed of 150 kt at the runway threshold

(*7) : Assuming that the approach speed at the runway threshold is 4 kt faster than VREF in the same manner as this case

2.10.4 Material by the Designer and the Manufacturer of the Aircraft

(1) Autobrake setting and transition to manual braking

“Wheel Brakes” in the Flight Crew Training Manual (hereinafter referred to as “FCTM”) prepared by the designer and the manufacturer of the Aircraft includes the following description: (excerpt)

Automatic Brakes

(omitted)

Settings include:

- *MAX: Used when minimum stopping distance is required. Deceleration rate is less than that produced by full manual braking*
- *3: Should be used for wet or slippery runways or when landing rollout distance is limited. If adequate rollout distance is available, autobrake setting 2 may be appropriate*
- *1 or 2: These settings provide a moderate deceleration suitable for all routine operations.*

Transition to Manual Braking

(omitted)

When transitioning from the autobrake system to manual braking, the PF should notify the PM. Techniques for release of autobrakes can affect passenger comfort and stopping distance. These techniques are:

- *stow the speedbrake handle. When stopping distance within the remaining runway is assured, this method providing a smooth transition to manual braking is effective before or after thrust reversers are stowed, and is less dependent on manual braking technique*
- *smoothly apply brake pedal force as in a normal stop, until the autobrake system disarms. Following disarming of the autobrakes, smoothly release brake pedal pressure. Disarming the autobrakes before coming out of reverse thrust provides a smooth transition to manual braking*
- *manually position the autobrake selector off (normally done by the PM at the direction of the PF).*

(2) Deceleration rates by Autobrakes

“Landing Application Logic” in the Aircraft Maintenance Manual prepared by the designer and the manufacturer of the Aircraft includes the description of the left table below (excerpt) regarding deceleration rates with autobrakes. Based on this, the deceleration rates are corrected into longitudinal accelerations (G) as shown in the right table.

<i>AUTO BRAKE Select Switch</i>	<i>Deceleration Rate (ft/sec/sec)</i>	Deceleration rate longitudinal accelerations (G)
<i>1</i>	<i>4</i>	about -0.12
<i>2</i>	<i>5</i>	about -0.16
<i>3</i>	<i>7.2</i>	about -0.22
<i>MAX</i>	<i>14 (> 80 knots) 12 (< 80 knots)</i>	about -0.44 about -0.37

2.10.5 Air Traffic Control System

Air traffic control system in Japan is prescribed in III Standards for Air Traffic Control Procedure in the Chapter 5 Air Traffic Services Procedure Handbook in the Air Traffic Service Procedure Handbook (hereinafter referred to as “Standard for ATC Procedure”) by the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism.

The clause of 2. ATC Instructions (III) Aerodrome Control Procedure in the Standards for ATC Procedure describes “instructions for vacating runways” and “crossing runways” as follows: (excerpt)

- (9) a *Provide instructions to arriving aircraft regarding the taxiway and others to vacate the landing runway at the appropriate timing as necessary.*
(IF ABLE) TURN LEFT / RIGHT [turning point] .
Note: Pilot is to vacate the runway via the taxiway that would achieve the shortest runway occupancy time unless instructed by the air traffic controller otherwise.
- b *In case of the following, provide instructions regarding taxiing. (omitted)*
- (c) *If there is a need to have the arriving aircraft hold short of another runway, taxiway or others.*
- (12) a *When the aircraft, which needs to taxi by crossing a runway, moves close to the said runway, issue an instruction to cross the runway or to hold short of the runway.*
CROSS RUNWAY [number] .

3. ANALYSIS

3.1 Qualification of Personnel

Both the Captain and the F/O held valid airman competence certificates and valid aviation medical certificates.

3.2 Aircraft Airworthiness Certificates

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

3.3 Relations to Meteorological Condition

As described in 2.6, visibility was favorable and few cloud was seen at a low altitude at Niigata Airport at around the related time of this serious incident. According to the records from the anemometers placed in Niigata Airport, the wind direction and wind velocity were about 040° and 3 to 4 kt and weak, and few fluctuations was observed; therefore, it is highly probable that there was

no tailwind component upon landing on RWY 10. In addition, no rain was observed on the day of the serious incident; alternatively the runway condition was dry.

With all these factors, it is highly probable that the meteorological condition at the time had no bearing with the occurrence of this serious incident.

3.4 Situation Leading up to Overrunning

3.4.1 Final Approach

As described in 2.1, the Captain taking in the left seat as PF began to conduct the VOR approach on RWY 10 in Niigata Airport. The Captain called “Stabilized” to verify that the attitude of the Aircraft for approach was stable at around 1,000 ft and disengaged the autopilot and then auto throttle.

According to the DFDR records and statements in 2.1.2, VREF at this approach was 146 kt, and then the Captain set the target speed as 151 kt as usual, which was 5 kt added to the VREF. The Aircraft was generally approaching with the target speed.

According to the statements in 2.1.2, it is highly probable that the Aircraft was flying along with a slightly larger descent path at the beginning of the approach, judging from the indication of PAPI. Therefore, as described in 2.10.1, it is highly probable that the Captain tried to correct the descent path with a slightly larger descent rate of about 1,090 ft/min (the normal 3° path with 151 kt is equivalent of about 800 ft/min) at 1,000 to 500 ft RA. As a result, seeing that the descent rate at 500 to 50 ft RA was showing about 770 ft/min, it is highly probable that the Aircraft could continue to approach along with basically reasonable descent path.

3.4.2 Touchdown

According to the DFDR records, at 19:40:46, the Aircraft passed over RWY 10 threshold at about 50 ft RA and the airspeed of 150 kt, and the Captain initiated a flare at about 30 ft RA, which was a standard operation.

As described in 2.1.1, at 19:40:52, the main landing gears of the Aircraft touched down at the airspeed of 143kt. Then the speed brakes (the spoilers) automatically started to deploy. At 19:40:55, the F/O called “Speed brakes up,” and the Captain replied “Check.” It is highly probable that the lift generated by the main wing was reduced along with increasing the drag itself by the deployment of the spoilers, as a result, the braking by the wheel brake was starting to work effectively.

According to the DFDR records, the touchdown point of the Aircraft was about 600 m from the RWY 10 threshold (about 1,900 m of runway remaining length available).

3.4.3 Deceleration with the Autobrakes

About two seconds after the main landing gears touched down, the Captain set the thrust levers to the reverse position, and then the full reverse was set at 19:40:57, followed by the F/O’s call of “Two Reverse Green” at 19:40:59, around when, six through seven seconds after the touchdown of the main gears, the nose gear of the Aircraft touched down .

At 19:41:09, when the F/O called “Eighty”, which was to be called out upon checking the speed of 80 kt, the speed of the Aircraft indicated about 88 kt. In response to this, the Captain called “Reverse idle” and started to gradually retard the thrust levers from the full reverse position.

Regarding the timing to retard the thrust levers from the full reverse position, POM, described in 2.10.3(1), stipulates to “maintain reverse thrust as required, up to maximum, until the airspeed approaches 80 knots” and according to FOM, described in 2.10.3(3), stipulates to “do not use max

reverse thrusts below 80 knots except for emergencies.” It is probable that the Captain’s operation, retarding the thrust levers from the full reverse position with referring to the call of “Eighty”, was basically followed the standard procedure in POM and FOM. Since the call of speed “Eighty” by the F/O was made at 88 kt as described above, the Captain had consequently started retarding the thrust levers from the full reverse position at the slightly earlier timing.

Along with the operation of retarding the thrust levers from the full reverse position, the brake pressure on the main wheels was gradually increased. Auto brake system takes automatic control to follow the selected decelerating rate while preventing wheels from skidding with the antiskid/auto brake system. Therefore, it is highly probable that the increment of this brake pressure was produced by regulating the deceleration rate of autobrake-2, about -0.16 G, which was selected. According to the DFDR records, the longitudinal acceleration of -0.14 to -0.18 G, including temporary value of -0.22 G, which was corresponding to the deceleration rate, was steadily observed after landing.

3.4.4 Deceleration with Manual Brake

As described in 2.1.1, the Captain stowed the speed brake lever at 19:41:17, which triggered the spoilers to be stowed and concurrently the autobrakes to be disarmed as described in 2.10.4(1), with the airspeed of 69 kt at the moment. Subsequently, since the brake pressure in lower range had been maintained for about eight seconds, the deceleration rate was getting reduced, it is highly probable that the Captain did not apply the manual brake or the brake control by the Captain did not function well enough.

As described in 2.1.1, it is probable that because the Captain was going to roll to the end of the runway and not to reduce the Aircraft to taxi speed as long as remaining runway length was too long, in order to reduce the runway occupancy time, when the Captain disarmed the autobrakes.

It seemed that the Company regulations and others did not specifically describe when the autobrakes shall be disarmed. However, it is somewhat likely that the Company did not assume that pilots might disarm the autobrakes at such an early timing, as far as judging from the description in 2.10.3(1) “Before taxi speed, disarm the autobrakes. Use manual braking as needed.” In case that the Captain had intentionally disarmed the autobrakes as fast as the airspeed of 69 kt, the Captain should have continued manually braking in a proper manner so that the Captain could get the suitable speed and deceleration rate in proportion to the available remaining length of the runway.

As described in 2.1.1, since the brake pressure began to drastically rise and the deceleration rate grew at the speed of 56 kt at 19:41:29, it is highly probable that the Captain and the F/O strongly applied brake at the moment.

As described in 2.1.1, since both the vertical and longitudinal accelerations fluctuated at 19:41:34, it is highly probable that the Aircraft trespassed into the grass from the overrun area at the moment.

3.5 Consideration of the Landing Distance

According to the statements in 2.1.2, it is highly probable that the Captain and the F/O confirmed the landing distance of about 7,000 ft (about 2,130 m) and understood that they had the margin of 1,000 ft (about 300 m) or more in consideration with the RWY 10 runway length of 8,200 ft (2,500 m). As described in 2.10.3(5), the landing distance with the landing configuration, using autobrake-2 and Flap-30, was about 2,300 m; therefore, they could have enough length to safely

land on a 2,500 m long runway numerically.

By using Flap-40 in lieu of Flap-30, or using autobrake-3 in lieu of autobrake-2, the landing distance might be shortened. However, as described in 2.10.4(1), autobrake-1 or autobrake-2 could produce the moderate deceleration rate, which was reasonably suitable for daily operations, and Flap-40 might not be used in a usual situation during landing. Therefore, it is probable that the Captain followed a standard operational procedure to select autobrake-2 and Flap-30. It is highly probable that the Aircraft would not have resulted in an overrun, if the speed brake lever had not been stowed and the autobrakes had been continuously used, since the autobrakes had controlled the wheel brake pressure to maintain the deceleration rate in a certain level even if restoring of thrust reversers.

At the time of the serious incident, the landing distance had been grown longer by some factors such as, not strong but light head wind, higher temperature in summer, down slope of the landing runway and heavy landing weight with a lot of fuel loaded, and others. The Captain should have considered the landing configuration of the Aircraft, while being aware of the operation of the speed brake lever which caused disarming the autobrakes and the following manual braking, and should have reduced speed in a proper manner corresponding to the available remaining distance of the runway.

3.6 Air Traffic Control Instructions

3.6.1 Intention of the Air Traffic Controller

As described in 2.1.1, the Niigata Tower instructed the Aircraft of the exit taxiway “turn right end of runway B1,” and jointly made the taxi clearance including crossing the intersecting runway after vacating the runway “taxi to spot cross runway 04/22.”

According to the statements in 2.1.2(4), it is highly probable that Air Traffic Controller in the Niigata Tower instruct the exit taxiway accompanied with the phrase of “end of runway” on a regular basis in order that the Aircraft which landed on RWY 10 would not wrongly enter the intersecting RWY 04/22. It is highly probable that the Controller gave this same instruction phrase because the Controller thought that it was difficult for the Aircraft to vacate from TWY-P3, while the Aircraft was rolling around TWY-P3. It is also highly probable that the Controller gave consideration in order for the Aircraft on TWY-C1 not to get the clearance of crossing RWY 04/22 after vacating the runway and to let the Aircraft continue smooth taxiing.

The F/O responded to the ATC instruction, starting with “Cross runway 04/22,” which was indicating crossing of the intersecting runway, then followed by “end of runway right turn,” which is indicating turning to the right at the end of the runway. In general, every reading back by pilots is not configured to be in the same sequence as the ATC instruction. Therefore, it is highly probable that it was difficult for the Controller of the Niigata Tower to notice that the pilots might misapprehend the ATC instruction when the F/O had read back “Cross runway 04/22” in an inverted sequence.

In addition, it is highly probable that the Controller of the Niigata Tower could not imagine that flight crewmembers of the Aircraft misapprehended “the taxi clearance including crossing the intersecting runway after vacating the runway,” which was issued after the landing, as “the clearance to cross the intersecting runway during the landing roll” because the Air Traffic Controller had already issued the landing clearance, in which the pilots were approved to use entire of RWY 10.

3.6.2 Situations and Recognition of the Captain and the F/O

According to the statements in 2.1.2, the Captain had not flown to Niigata Airport for more than a year and a half, and the F/O had never experienced to land at night on RWY 10 in Niigata Airport. It is highly probable that the Captain and the F/O had a heavy workload, such as the verifying of the exit taxiway as well as the control for reducing speed and callout after landing, since the Captain and the F/O were not familiar with Niigata Airport which had a intersecting runway, while ground objects and others which pilots could observe during a night landing were limited. It is also somewhat likely that it was difficult for the Captain and the F/O to feel how fast they are in the low speed ground roll area in which they did not count on the airspeed indicator.

Under such circumstances, as described in 2.1.1, the F/O immediately made a read-back for the instruction of the Niigata Tower to “turn right end of runway and taxi to spot cross runway 04/22” at 19:41:16, just before when the F/O was about to get started to call of “Sixty” (airspeed 60 kt), which was a standard callout following POM described in 2.10.3(1). According to the description in 2.1.1 and the statements 2.1.2(1) and (2), it is highly probable that the Captain and the F/O misapprehended the intention of instruction of the Niigata Tower to “cross runway 04/22,” in which they assumed that the Controller issued the clearance to cross the intersecting runway during landing roll, without understanding the meaning of the instruction.

According to the statements in 2.1.2, it is highly probable that the Captain and the F/O had recognized through the Company Notice that they were not allowed to vacate from the intersecting RWY 04/22 in Niigata Airport. Therefore, it is highly probable that the Captain intended to vacate the runway from TWY-B1 after passing over the exit to TWY-P3 and rolling through the intersection of RWY 04/22. Under such circumstances, it is highly probable that the Captain did not reduce the speed of the Aircraft lower enoughly, while paying attention to where the Aircraft was rolling, and that the Captain could not grasp the situation well enough to think about the taxi route when he received the instruction of “cross runway 04/22.”

It is probable that the Captain and the F/O believed that they were short of the intersection of RWY 04/22 and understood the red lights (runway threshold lights) that they observed ahead, as the stop bar lights in front of RWY 04/22, associated with the ATC instruction of “cross runway 04/22.”

As described in 2.8.2(1), stop bar lights are placed on taxiways and do not exist on a runway. According to the statements in 2.1.2, it is somewhat likely that the Captain and the F/O might be developing an unusual feeling around that moment, because they did not observe runway centerline lights, runway edge lights, runway threshold lights and others beyond the red lights, which they thought as the stop bar lights. However, it is highly probable that the Captain let the Aircraft approach to the red lights, indeed they are the runway threshold lights, while the Captain was holding a doubt, since they had received the instruction to cross the runway from the Niigata Tower. It is highly probable that the Captain and he F/O did not have enough time to confirm with the Niigata Tower or discuss among them about the meaning of the instruction of “cross runway 04/22” at this point. Accordingly, it is highly probable that when the Captain realized there was no runway beyond the red lights, the Aircraft could not stop within the runway anymore, resulting in overrun.

According to the statements in 2.1.2 and the DFDR records, it is probable that the Captain could not take sufficient control of reducing speed with manual braking because of the following reasons:

- The Captain normally judges the runway remaining length with using runway centerline lights, which varies in color according to length, though, the Captain could not notice the remaining length of the runway.

- The F/O was also saying that the Aircraft was slightly too fast to stop short of the red lights.
- The brake pressures had dropped after the disarming of the autobrakes.

The F/O immediately made a read-back when the Controller instructed the exit taxiway, while they had a heavy workload, which had led the F/O to skip the call of “Sixty”. Confirming the speed of 60 kt is important for PF to adjust the following deceleration rate, it is probable that it was possible for the F/O to prioritize the call of “Sixty” over the read-back for the ATC instructions or the advise to the Captain where the Aircraft was rolling.

3.6.3 Taxi Clearance (Instruction)

Regarding that the Controller in Niigata Tower cleared the Aircraft to taxi and cross RWY 04/22 in early stage after landing on RWY 10, it is probable that this instruction might be effective in the light of facilitating the traffic flow for those pilots who have relatively more experiences to fly to Niigata Airport and are familiar with the controller’s phraseology there. However, it is highly probable that the ATC instruction of the Niigata Tower in this case, which was considerate of the pilots, led the pilots, who were not familiar with the controller’s phraseology in Niigata Airport, to their misapprehension, despite the intention of the Controller.

Since pilots generally are holding a heavy workload after landing through the landing roll, air traffic controllers shall instruct the exit taxiway and the following taxi clearance “at the appropriate timing as necessary,” as described in 2.10.5. Especially in the case that air traffic controllers give instructions for vacating runways and crossing runways during taxi, the air traffic control authority need to consider that should refrain from issuing more than one clearances at one time and others in some cases, as well as they should issue the instruction at the right timing, in order that those instructions should not result in the event such as the runway incursion.

3.7 Aeronautical Lights

As described in 2.8.2, the front part of 200 m of the runway centerline lights were out of service when the Aircraft landed on RWY 10. However, it is highly probable that the partial inoperative status of the runway centerline lights did not affect the Captain’s maneuvering to make the Aircraft land and come to stop, since the Captain did not notice that the runway centerline lights were partially out of service according to the CVR records described in 2.1.1, and the Captain could successfully make the Aircraft land at the proper touchdown point.

Taxiway centerline lights on TWY-B5 were also partially out of service. However, it is highly probable that they were not relevant to the occurrence of this serious incident, since TWY-B5 is the nearest taxiway to RWY 10 approach end and those lights do not affect an aircraft other than departing from RWY 10 or landing on RWY 28.

Upon landing on RWY 10, an aircraft would be led to use TWY-B1 when an aircraft could not decelerate well enough to enter TWY-P3. As described in 2.8.2(1), TWY-P3 and TWY-B1 have taxiway guidance lights indicating exits for taxiways and taxiway centerline lights, as well as some signs that indicate their positions. On the other hand, no sign or light for RWY 04/22 is placed between TWY-P3 and TWY-B1; therefore, pilots, especially in the midst of night landing roll on RWY 10, have no other choice but to watch the runway edge lights as an essential guidance to find the intersection with RWY 04/22. The flight crewmembers during landing rolling was paying their attention towards the terminal building side, corresponding to their right side of view, in which they might feel that the intervals of the runway edge lights of RWY 04 looks longer than those are since RWY 04/22 intersects with RWY 10 at about 60°. With all these factors, it is probable that the

flight crewmembers have difficulties to get the picture of the intersecting with RWY 04/22.

As described in 3.6.2, since the Captain and the F/O had already recognized that they were not allowed to vacate from the intersecting RWY 04/22, it is highly probable that they had intended to continue rolling until TWY-B1, the end of the runway, as being conscious of the sequence that passing over the side of TWY-P3 and then crossing the intersecting runway. However, the Captain had the Aircraft continuously roll in parallel with looking for the intersection with RWY 04/22 which was assumed far ahead, having trouble to figure out the position; therefore, it is somewhat likely that those circumstances contributed that the Captain did not let the Aircraft reduce enough lower speed.

4. CONCLUSIONS

4.1 Summary of Analysis

- (1) The Aircraft made the VOR approach on RWY 10 in Niigata Airport. It is highly probable that the Aircraft could continue to approach along with basically reasonable descent path under 500 ft RA. The Aircraft passed over RWY 10 threshold at about 50 ft RA and the airspeed of 150 kt, and the Captain initiated a flare at about 30 ft RA, which was a standard operation.

The touchdown point of the Aircraft was about 600 m from the RWY 10 threshold, then the speed brakes automatically started to deploy. (3.4.1, 3.4.2)

- (2) After the main landing gears touched down, the Captain set the thrust levers to the full reverse position. The F/O called “Eighty” at the speed of about 88 kt, and in response to this, the Captain started to gradually retard the thrust levers from the full reverse position. It is probable that the timing of this operation was basically followed the standard procedure in POM and FOM. Along with the reverse retarding operation, the Aircraft was controlled to maintain the selected deceleration rate of -0.16 G with the autobrakes. (3.4.3)
- (3) The Captain stowed the speed brake lever, which triggered the spoilers to be stowed and concurrently the autobrakes to be disarmed. Since the brake pressure in lower range had been maintained and the deceleration rate was getting reduced, it is highly probable that the Captain did not apply the manual brake or the brake control by the Captain did not function well enough.

It is probable that because the Captain was going to roll to the end of the runway and not to reduce the Aircraft to taxi speed as long as remaining runway length was too long, in order to reduce the runway occupancy time, when the Captain disarmed the autobrakes.

Since the brake pressure began to drastically rise and the deceleration rate grew at the speed of 56 kt, it is highly probable that the Captain and the F/O strongly applied brake at the moment. (3.4.4)

- (4) It is probable that the Captain followed a standard operational procedure to select autobrake-2 and Flap-30. However, since the landing distance had been grown longer by some factors, the Captain should have considered the landing configuration of the Aircraft, while being aware of the operation of the speed brake lever and the following manual braking, and should have reduced speed in a proper manner corresponding to the available remaining distance of the runway. (3.5)
- (5) It is highly probable that the Niigata Tower gave the instruction of “turn right end of

runway B1 and taxi to spot cross runway 04/22,” in order to approve the Aircraft not to get the clearance of crossing RWY 04/22 after vacating the runway and to let the Aircraft continue smooth taxiing. It is highly probable that it was difficult for the Controller of the Niigata Tower to notice that the pilots might misapprehend the ATC instruction when the F/O made a read-back in an inverted sequence.

It is also highly probable that the Controller of the Niigata Tower could not imagine that flight crewmembers of the Aircraft misunderstand “the taxi clearance including crossing the intersecting runway after vacating the runway,” which was issued after the landing, as “the clearance to cross the intersecting runway during the landing roll.” (3.6.1)

- (6) It is highly probable that the Captain and the F/O misapprehended the intention of the instruction of the Niigata Tower to “cross runway 04/22,” in which they assumed that the Controller issued the clearance to cross the intersecting runway during landing roll. It is probable that the Captain and the F/O understood the red lights that they observed ahead, as the stop bar lights in front of RWY 04/22, associated with the ATC instruction of “cross runway 04/22.” Stop bar lights do not exist on a runway; therefore, it is somewhat likely that the Captain and the F/O might be developing an unusual feeling, because they did not observe any lights beyond the red lights, which they thought as stop bar lights. However, it is highly probable that the Captain let the Aircraft approach to the red lights, indeed they are the runway threshold lights, while the Captain was holding a doubt, since they had received the instruction to cross the runway from the Niigata Tower.

It is probable that the Captain could not take sufficient control of reducing speed with manual braking. (3.6.2)

- (7) Air traffic controllers shall instruct the exit taxiway and following taxi clearance “at the appropriate timing as necessary.” (3.6.3)
- (8) The Captain had the Aircraft continuously roll in parallel with looking for the intersection with RWY 04/22 which was assumed far ahead, having trouble to figure out the position; therefore, it is somewhat likely that those circumstances contributed that the Captain did not let the Aircraft reduce enough lower speed. (3.7)

4.2 Probable Causes

It is highly probable that this serious incident occurred when the Aircraft landed on RWY 10 in Niigata Airport, the Captain did not let the Aircraft reduce enough lower speed to approach the runway threshold lights that the Captain understood as the stop bar lights for the intersecting RWY 04/22, which the Captain was holding a doubt, and when the Captain realized there was no runway beyond the red lights, the Aircraft could not stop within the runway anymore, resulting in overrunning.

It is highly probable that the reasons why the Captain understood the runway threshold lights as the stop bar lights for the intersecting RWY 04/22, and why the Captain did not let the Aircraft reduce enough lower speed to approach the lights, are as follows:

- (1) Both the Captain and the F/O presumed that the ATC instruction “cross runway 04/22” from the Niigata Tower was “the clearance to cross the intersecting runway during landing roll” rather than “the taxi clearance including crossing the intersecting runway after vacating the runway,” unable to understand the intention of the instruction, and both of them believed the Aircraft was short of the intersecting runway.
- (2) The Captain was going to roll to the end of the runway; therefore, he disarmed the

autobrakes as fast as about 70 kt. After that the Captain could not take appropriate control of reducing speed with manual braking, even though he should have reduced speed in a careful manner.

It is also somewhat likely that the following reasons contributed to the occurrence of this serious incident:

- The Captain and the F/O were not familiar with Niigata Airport which had a intersecting runway, and they had difficulty to identify the intersecting position with RWY 04/22 because ground objects and others which pilots could observe during night landing were limited. In such circumstances, it was difficult for them to judge the speed of the Aircraft in the low speed area in which they did not count on the airspeed indicator.

5. SAFETY ACTIONS

5.1 Safety Actions Taken

5.1.1 Safety Actions Taken by the Company

The Company took the following measures to prevent the occurrence of similar cases.

5.1.1.1 Revision of Regulations

(1) FOM

The Company added the noted item in “General Operational Policy” that it is very important for PM to monitor or advise in the case when it is possible for PF to be in the lowered capacity of situation awareness.

The Company also described an additional item of “Auto Brakes mode” among the landing briefing in “NORMAL OPERATIONS – Enroute.”

(2) POM

The Company added the following items in “Descent Procedure/Callout” of “5 NORMAL OPERATIONS – DESCENT”

- Compute landing performance by using LDC (Landing Distance Calculation) with the ground support or QRH.
- Use Flap-40 when landing performance is limited by runway length, tailwind, etc.
- Autobrake-3 or greater is used when the landing distance available is less than 9,000 ft or the runway condition is other than dry.

In addition, the Company added the following items “Landing Roll Procedure/Callout” of “5 NORMAL OPERATIONS – APPROACH AND LANDING”:

- PF shall call “MANUAL BRAKES” when disarmed the autobrakes.
- The speed at which the transition from autobrakes to manual braking is made depends on aircraft deceleration rate, runway conditions and others.
- The aircraft must be decelerated to an appropriate safe taxi speed (maximum 30 kt) before 1,000 ft from the planned runway exit point.

(3) QRH

All reference distances and adjusted distances described in QRH have been increased by 15 %.

5.1.1.2 Review of Training

The Company reviewed the required number of landing experience with Flap-40 in the Boeing 737 training:

- Number of experience: at least 10 times for Captain, 5 times for F/O

5.1.1.3 Revision of Materials regarding Niigata Airport

On August 27, 2013, the Company featured the summary of this serious incident in the internal information of “K-FILE” (Note-1) in order to raise awareness among flight crewmembers of the Company. Moreover, on September 27, 2013, the Company accomplished improvement and development of materials of Niigata Airport in the “K-FILE” up to 12 pages from 5 pages contained in its original, in which the detailed information, ATC recordings, photographs, video clips and others of the airport and runways, were added.

(Note-1): “K-FILE” refers to KAL’s supplemental materials in multimedia style that combine documents, charts, video clips, ATC recordings and others, which provides flight routes and airport information for flight crewmembers’ reference to enhance operational safety. K-FILE has been approved by MOLIT, or the Korean Ministry of Land Infrastructure and Transport, and Captains are required to complete the study for specific airports with K-FILE to meet the initial and recurrent qualification. In case that the flight crewmembers have not flown to the airport for more than three months or in case that new information has been updated in K-FILE, the flight crewmembers are required to review the K-FILE of the airport at the briefing prior to the flight.

5.1.2 Actions Taken by the Niigata Airport Office, Tokyo Regional Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Based on the occurrence of this serious incident, from the standpoint of preventing a wrong recognition in the radio communication between pilots and air traffic controllers, the Niigata Airport Office, Tokyo Regional Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism, modified the practical procedure in air traffic control and informed to air traffic controllers in its own office on November 6, 2014 as follows, and then carried into effect on November 10.

Modification in the phraseology for air traffic controls

Air traffic controller, intending to issue taxi clearance to the gate for the aircraft rolling after touchdown on runway 10, shall direct to vacate runway 10 and cross runway 04/22 separately as necessary. Then the controller shall verify the pilot's readback of the instruction.

Reference example

(Upon issuing the instruction of vacating runway10)

Controller: (Call Sign), turn right end of runway Bravo One (B1).

Pilot : (Call Sign), roger, turn right end of runway Bravo One (B1).

Controller: (Call Sign), affirm.

To perform hear-back for sure, air traffic controller shall try to transmit “Affirm” wherever possible when the pilot’s read-back was correct regarding ATC instruction of crossing runway 04/22.

(Upon issuing the instruction of crossing runway 04/22)

Controller: (Call Sign), taxi to spot, cross runway (04 or 22).

Pilot : (Call Sign), roger, taxi to spot, cross runway (04 or 22).

Controller: (Call Sign), affirm.

Figure 1 Estimated Landing Roll Diagram

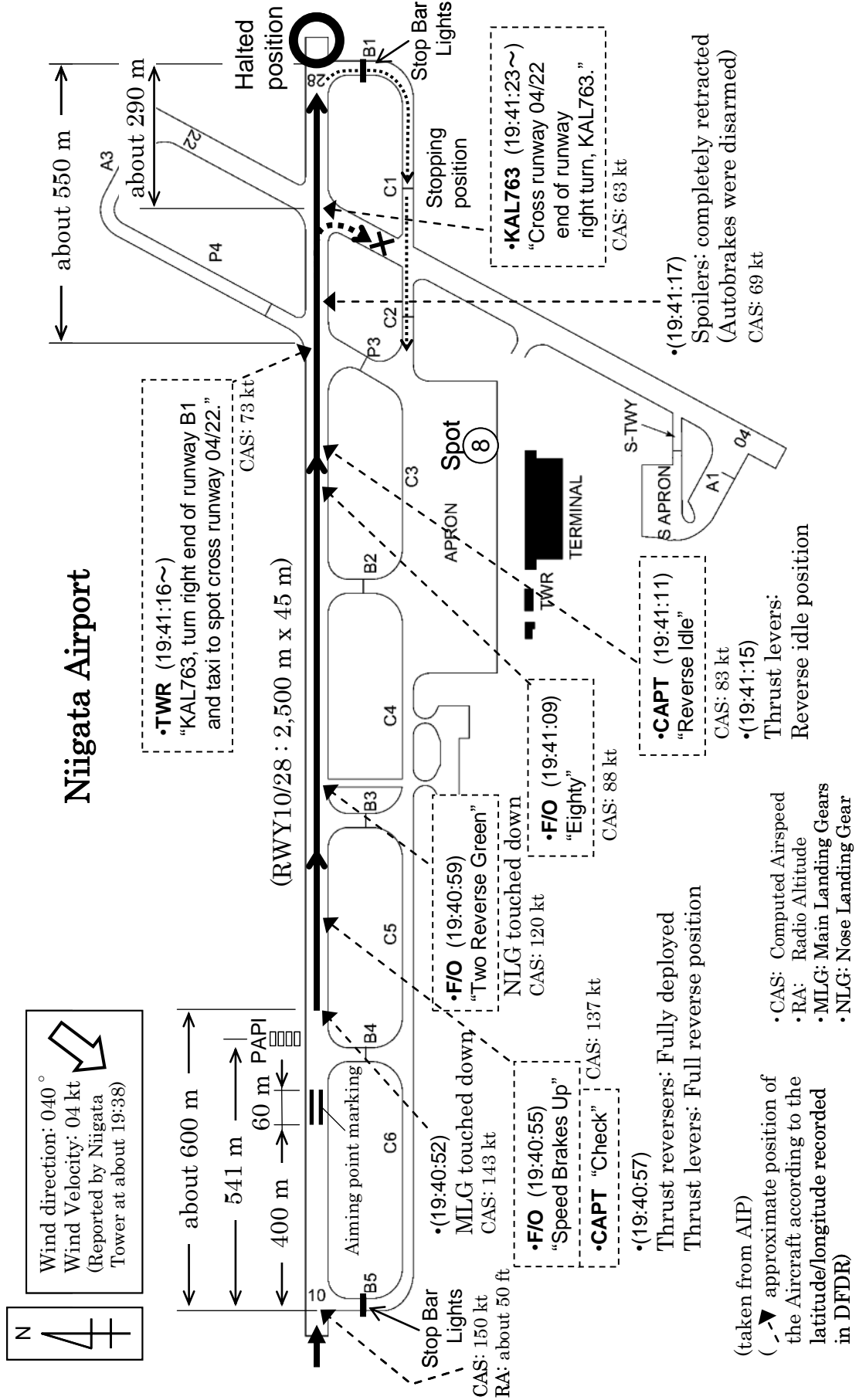


Figure 2 Three Angle View of Boeing 737-900

Unit: m

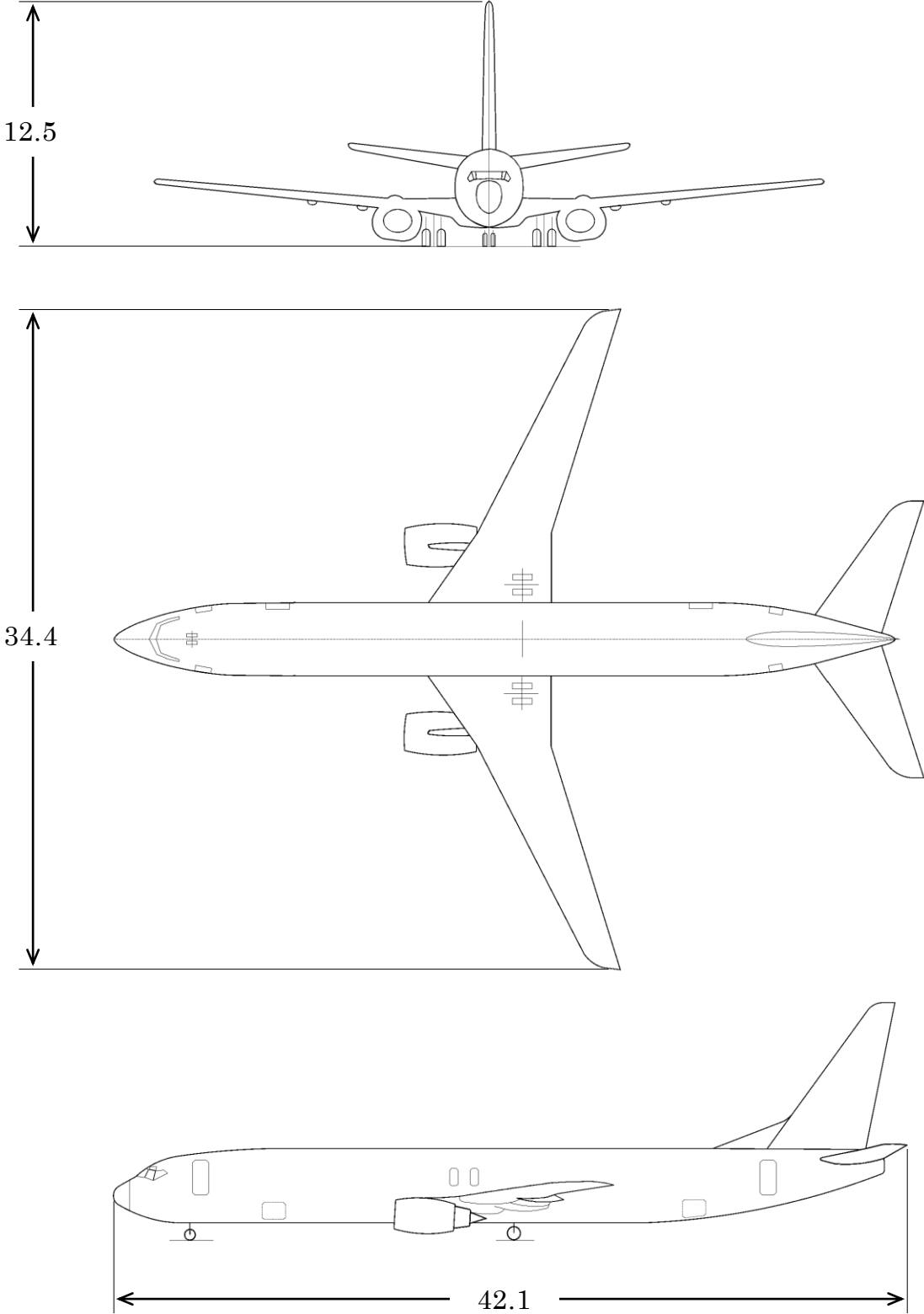
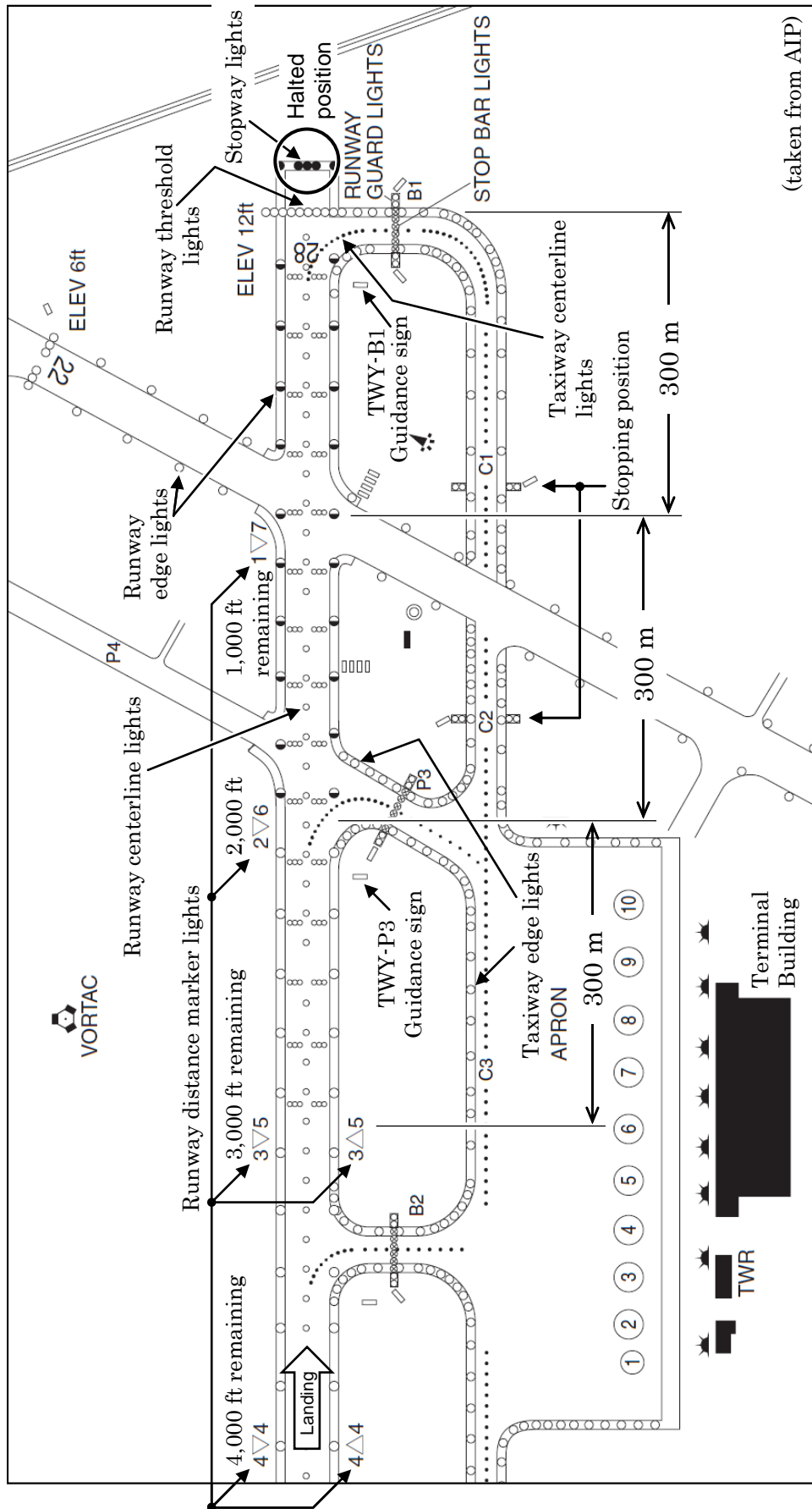
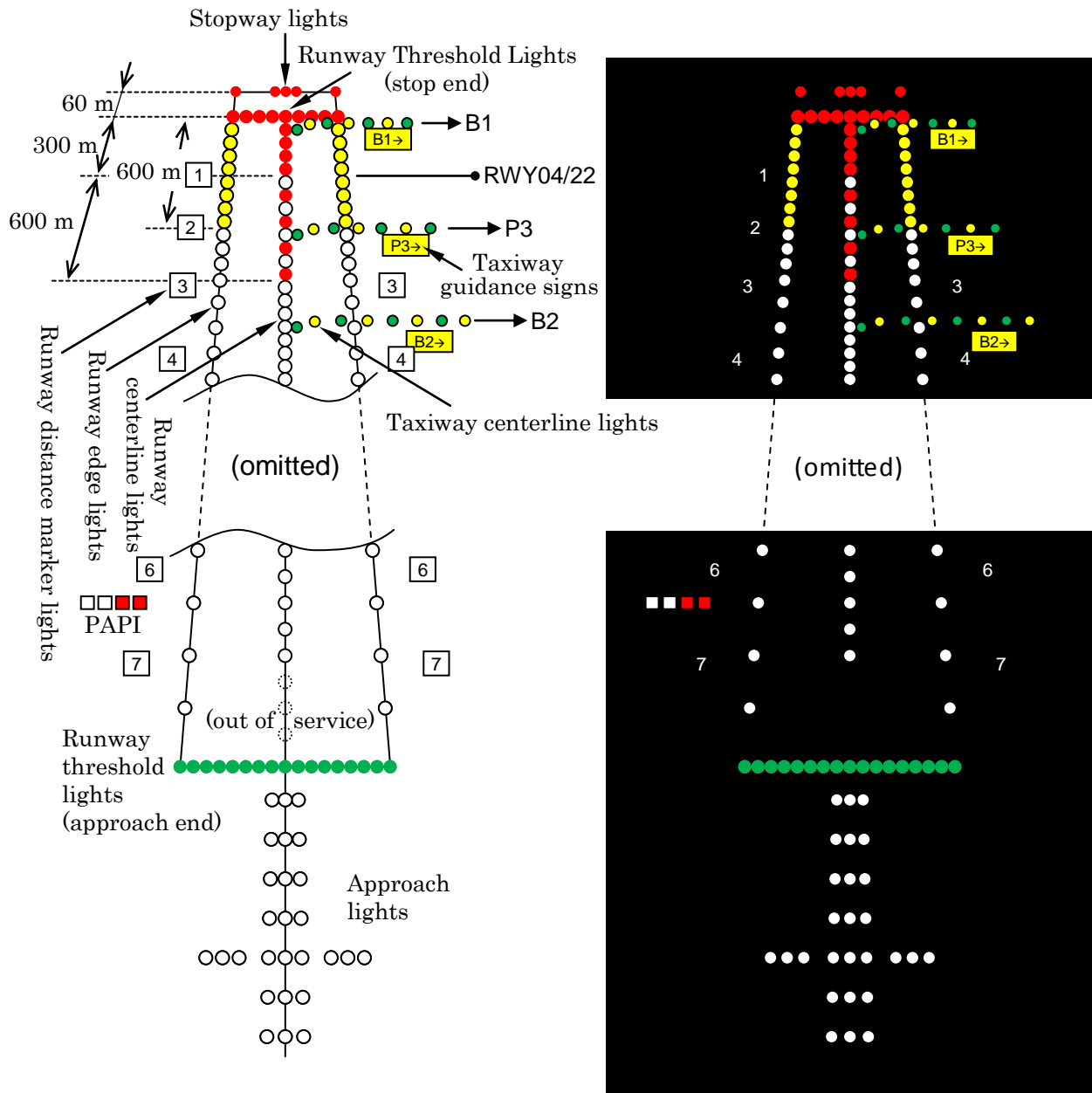


Figure 3 Lights and others around the End of RWY 10



(taken from AIP)

Figure 4 Actual Lighting Status on RWY 10 at the Occurrence of the Serious Incident



Note: Differs from how it appears

Figure 5 DFDR Records

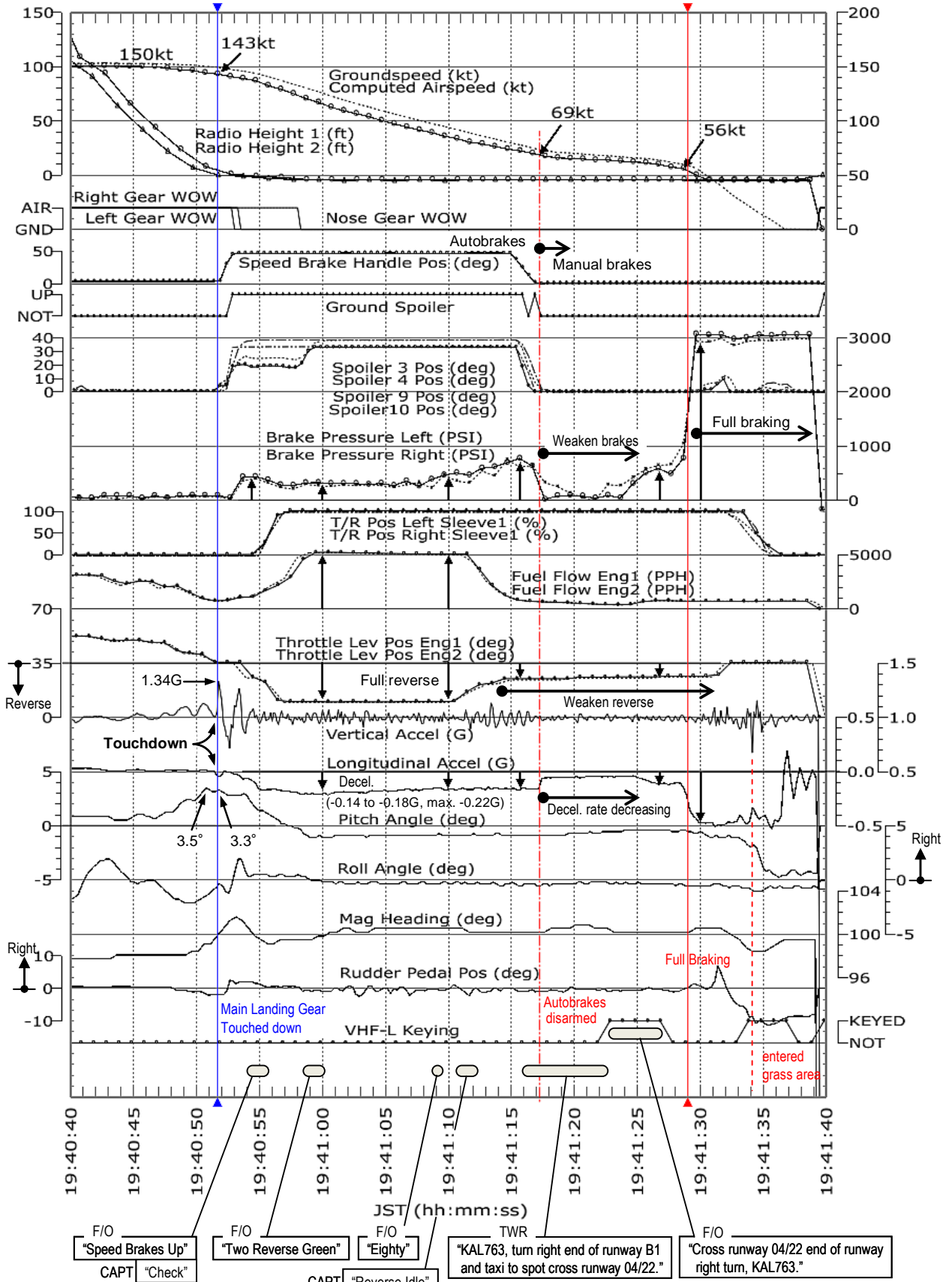
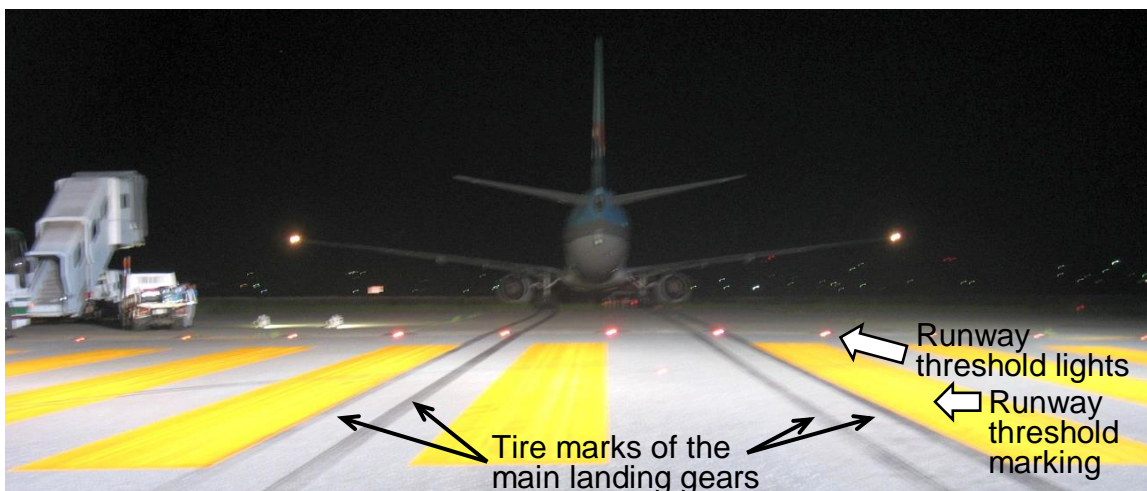


Photo 1 Serious Incident Aircraft



Photo 2 Serious Incident Site



Attachment Records of ATC Communications

August 5, 2013

Radio frequency: 118.0MHz

Japan Standard Time (hh:mm:ss.s)	Voice	Contents
19:37:35.9	KAL763	Niigata Tower, good evening, Korean Air seven-six-three. Ah..runway one zero, nine ah..nine miles out.
19:37:43.7	Tower	Korean Air seven-six-three, Niigata Tower, good evening. Runway one zero, continue approach.
19:37:48.5	KAL763	Continue, Korean Air seven-six-three.
		(Communication with other aircraft)
19:38:27.4	Tower	Korean Air seven-six-three, runway one zero, cleared to land, wind zero four zero at four.
19:38:33.1	KAL763	Cleared to land runway one zero, Korean Air seven-six-three.
		(Communication with other aircraft)
19:41:15.8	Tower	Korean Air seven-six-three, turn right end of runway Bravo one and taxi to spot cross runway zero-four/two-two.
19:41:23.4	KAL763	Cross runway zero-four/two-two, end of runway right turn, Korean Air seven-six-three.
19:41:37.1	KAL763	Ahh
19:41:45.3	Tower	Korean Air seven-six-three, Tower.
19:41:47.9	KAL763	Ahh
19:41:55.5	Tower	Korean Air seven-six-three, Niigata Tower.
19:41:58.4	KAL763	Korean Air seven-six-three, we're overshooting runway.
		(The rest is omitted)

KAL763: Korean Air seven-six-three

Tower: Niigata Tower