#### Accident Investigation into a Near Mid-Air Collision

June 12, 2005 Queenstown NZ

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## General

Date & Time :	January 31, 2001, 15:55(JST) or 06:55(UTC)
Location :	Over Suruga bay near Yaizu city,
Altitude :	About FL355 and FL357
Aircraft-Model (Re	gistration) : Boeing 747-400(JA8904) and Douglass DC-10 (JA8546)
Operator :	Japan Airlines (both)
Type of Operation	: Scheduled flight
Person on Board :	16-Crew 411-Passengers(B747-400)
	13-Crew 237-Passengers (DC-10)
Injuries : B747-400	Crew - 2 serious injury and 10 minor injury
	Passenger - 7 serious injury and 81 minor injury
DC-10	None
Aircraft damage:	B747-400 Minor damage in the cabin
	DC-10 None





#### Persons Concerned Flight Crew

Japan Airlines

Aircraft A( JAL907, Tokyo - Naha, Boeing 747 - 400D )
Left seat Captain (PF)
Right seat Co-pilot trainee (PNF)
Observer left seat Co-pilot
Observer right seat Co-pilot trainee

Aircraft B( JAL958, Pusan – New Tokyo, DC – 10 – 40)Left seatCaptain trainee( Co-pilot ) (PF)Right seatCaptain (PNF)Flight engineer seatFlight engineer



Person Concerned Air Traffic Controller

Tokyo Area Control Center

Kanto South C Sector

Radar Position : an ATC Trainee aATC Supervisor Radar Coordinator Position : aATC



# Sector configuration

Outline of KANTO SOUTH C Sector, TOKYO ACC



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### Abstract of the Accident-(1)

Boeing747-400D, JA8904 (Aircraft A) took off from Tokyo International Airport towards Naha Airport as Japan Airlines scheduled flight No.907 on 31 Jan 2001.

At that time, Douglas DC-10-40, JA8546 (Aircraft B) flew towards New-Tokyo (Narita) International Airport to the west of Aircraft A, as Japan Airlines scheduled flight No.958.

When Aircraft A was climbing while making a left turn above water off Yaizu city, Shizuoka prefecture, a CNF (Conflict Alert) was issued on the air traffic control radar display of Tokyo Area Control Center (Tokyo ACC) because Aircraft B was approaching from the west at the same flight level as Aircraft A.

An air traffic controller mistook the flight numbers of Aircraft A and Aircraft B, and advised Aircraft A to descend.





### Abstract of the accident-(2)

Although RA Resolution Advisory indicating to climb was issued by TCAS (Traffic Alert and Collision Avoidance System) equipped on Aircraft A just after the ATC instruction, Aircraft A continued descending maneuver in accordance with the ATC instruction.

As the RA indicating to descend was issued by TCAS equipped on Aircraft B, Aircraft B descended in accordance with RA.



## Plane geometry



### Abstract of the accident-(3)

Aircraft A and Aircraft B were approaching very close to each other, while both airplanes were visually recognized by each other. Both airplanes made avoidance maneuvers by visual observation of the other airplane just before crossing each other's flight path.

On that occasion, since Aircraft A made a rapid descent in order to pass under Aircraft B just before crossing, many passengers and CAs (Cabin Attendants) of Aircraft A got injured.



#### Flight path around location of accident



### Pictures at closest point





A galley cart that was jumped up to the ceiling of Aircraft A



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# Main Factors

#### 1. ATC

ATC trainee and ATC supervisor forgot Aircraft B.

ONF did alert 55 seconds before the closest point (later than usual because Aircraft A was turning.).

ATC trainee was upset and instructed to wrong aircraft.

#### 2. Aircraft

PIC of Aircraft A decided to descend complying with ATC instead of RA.

The flight crew of Aircraft A kept insight Aircraft B, but did not recognize relative position and height accurately.

Aircraft A did further dive to avoid collision with Aircraft B and then the accident happened.



#### Air Traffic Controllers forgot Aircraft B

ATC Trainee's consciousness was directed toward Aircraft C(AAL157) during radar hand off and communication establishment with Aircraft B.

He made communication with JAL952 (similar flight number to Aircraft B; JL958) just before establishing communication with Aircraft B.

He made communication with another aircraft continuously just after establishing communication with Aircraft B.

The presence of Aircraft B was not fixed sufficiently in his memory.

The ATC supervisor explained about the already conducted job to him. They continued lacking situational awareness on the radar display.





#### **Transcription**

#### During the time of initial contact with JAL958

- 15:47:02 [ATC] American one five seven, descend and maintain flight level three five zero, due to traffic.
- 15:47:14 [JAL952] Tokyo, Japanair nine five two, request direct VENUS.
- 15:47:18 [ATC] Japanair niner five two, stand by your request.
- 15:47: 56 [ATC] American one five seven, Tokyo control.
- 15:48:08 [ATC] **Japanair nine five two**, contact Narita approach, one two five decimal eight, request again please.
- 15:48:12 [**JAL952**] Roger.
- 15:48: 14 [JAL958] Tokyo control, Japan air nine five eight, flight level three seven zero.
- 15:48: 18 [ATC] Japan air niner five eight, Tokyo control, roger.
- 15:48: 21 [JAS296] Tokyo control, Airsystem two niner six, flight level two three zero.
- 15:48: 26 [ATC] Airsystem two niner six, Tokyo control, roger.
- 15:48: 37 [AAL157] Good afternoon, Tokyo, American one five seven, flight level three nine zero.
- 15:48:44 [ATC] **American one five seven**, Tokyo control, descend and maintain flight level three five zero, due to traffic.
- 15:48:49 [AAL157] Descend to flight level three five zero, due to traffic, leaving flight level three nine zero, American one five seven.



#### ATC Communications after CNF till the Closest Point

Total 6 communications were made between ATC and aircraft (Aircraft A or Aircraft B).

- All 6 communications have either mistakes or were not recognized by receivers.
- The reliability of communication decreased under pressing situations.

Air traffic controllers did not notice of issuance of RA in Aircraft A and in Aircraft B. They continued to issue ATC instructions for avoidance to aircraft.

It is necessary for ATC facilities to know issuance of RA in aircraft.



#### Radio communication and events between ATC and Aircraft

15:54:15 - CNF alerted controllers to confliction between JAL907 and JAL958
15:54:22-25 hem. JAL907, corre disregard.
15:54:27-32 JAL907, descend and maintain flight level 350, begin descent due to traffic.
15:54:33-38 JAL907, descend and maintain flight level 350, traffic insight.
15:54:35-38 (in back ground) climb climb climb.
15:54:38-41 Japanair 958, fly heading 130 for spacing.
15:54:49-52 Japanair 958, fly heading one t one four zero for spacing.

15:54:55-57 Japanair 957, begin descent.

15:55:02-05 Japanair 907, climb and maintain flight level 390.15:55:11- Crossed each other -



#### Aircraft A did not comply with RA indicating to climb

Aircraft A had already initiated a descending maneuver in accordance with the ATC instruction to descend when RA was issued.

Flight crew of Aircraft A thought that ATC instruction was issued considering the air traffic flow in the airspace of his jurisdiction.

Flight crew of Aircraft A was keeping aircraft B insight during descent.

Flight crew of Aircraft A worried about aircraft ability in high altitude.

They recognized insufficiently about the danger of maneuver opposite to the RA indication.



# Aircraft A continued descending

- It was difficult for flight crew of Aircraft A to understand the altitude difference with Aircraft B and to recognize accurately the movement of Aircraft B.
- They recognized insufficiently about the danger of maneuver opposite to RA.
- Their situational awareness by utilizing TCAS information displays was insufficient.
- The other flight crewmembers did not give any appropriate advice to comply with RA to the captain.





<u>The captain of Aircraft A recognized</u> <u>insufficiently about the danger to maneuver</u> <u>opposite to RA.</u> <u>The other flight crew did not give any</u> appropriate advice.

The expressions about RA in the operation manuals provided by the operator were insufficient.

The education and training about TCAS for flight crew was insufficient.

Training to perform the assigned role for TCAS operation was not conducted during CRM training.



Expressions about RA in the manuals for operation were insufficient

The following points relating to TCAS RA were not described in AIC issued by Civil Aviation Bureau and ICAO documents for aircraft operation.

- The importance to comply with RA
- Danger of maneuver opposite to RA
- RA should be complied with when ATC instruction and RA are issued simultaneously and both conflict with each other.



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### Recommendations to Minister for LIT (Items)-(1)

- 1 The reliable execution of air traffic control services
  - (1) The improvement of the issuing time of CNF
  - (2) Indication of RA information on the radar display for air route ATC

(3) The education and training to air traffic controllers



### Recommendations to Minister for LIT (Items) –(2)

- 2 Measures to be taken corresponding to issuance of RA in aircraft operation
  - (1) The measures to be taken corresponding to issuance of RA on aircraft
  - (2) The report of RA to the air traffic control facilities
  - (3) The request regarding TCAS to the ICAO
  - (4) The education and training for flight crewmembers
- 3 Fastening seat belts by passengers



#### Recommendations to Minister for LIT (contents)-(1)

2 Measures to be taken corresponding to issuance of RA in aircraft operation

#### (1) The measures to be taken corresponding to issuance of RA on aircraft

To clarify the measures to be taken by flight crew members when RA is issued, paying attention to the following points.

- a To comply with RA always except for a few exceptional cases corresponding to c or d below.
- b To mention clearly the danger of maneuver opposite to RA.
- c To mention as clearly as possible what kind of situations are the concrete cases where it is not appropriate to comply with RA.
- d To comply with RA in principle when a flight crewmember receives ATC instruction and RA simultaneously and both conflict. If at any chance it is necessary to comply with ATC instruction, to mention as clearly as possible such a case.



# Recommendations to Minister for LIT (contents)-(2)

2 Measures to be taken corresponding to issuance of RA in aircraft operation

#### (2) The report of RA to the air traffic control facilities

To report the issuance of RA promptly to air traffic control facilities at the earliest opportunity before the danger of collision is resolved.



### **Recommendations to ICAO-(1)**

1. Amendment of the PANS-OPS

To specify explicitly the compliance with an RA and the danger of maneuver contrary to an RA.

- (1) To amend ICAO Annex 6 or PANS-OPS Volume Part Chapter 3 "Operation of ACAS Equipment" to put explicitly that pilots should always comply with an RA with a few limited exceptions. Especially, pilots should comply with an RA when pilots receive simultaneously an instruction to maneuver from ATC and an RA, and both conflict.
- (2) To specify in PANS-OPS Volume Part Chapter 3 "Operation of ACAS Equipment" the danger of maneuvering in a direction opposite to that given in an RA, which has already been included in ICAO Annex 10 Volume Chapter 4 Appendix A, Guidance Material paragraph 3.5.8.10.3.



### **Recommendations to ICAO-(2)**

#### 2. Amendment of PANS-OPS

To specify as to when pilots should inform ATC of their deviation from an air traffic control clearance.

The current PANS-OPS Volume Part Chapter 3 "Operation of ACAS Equipment" paragraph 3.2 d) says that "pilots who deviate ... and shall notify the appropriate ATC unit as soon as practicable, of the deviation, including its direction and when the deviation has ended.".

It is possible to interpret this sentence that pilots may notify ATC after the conflict is resolved.

It is, therefore, necessary to specify explicitly that, in the case where a pilot executes evasive maneuvers following an RA, <u>the notification of deviation</u> to ATC shall be made promptly before the conflict is resolved unless it is difficult to do so due to the execution of evasive maneuvers.



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## **BFU Investigation**

- The mid-air accident between a DHL Boeing 757 freighter and a Bashkirian Tupolev Tu154M airliner happened near Ueberingen Germany in the midnight of 1 July 2002 killing 71 people onboard both aircraft.
- The BFU, in the course of investigation to the mid air-collision accident of July 2002, has released on 1 Oct. 2002 the following Safety Recommendation to ICAO:

Safety recommendation No. 18/2002

ICAO should change the international requirements in Annex2, Annex6 and PANS-OPS so that pilots flying are required to obey and follow TCAS resolution advisories (RAs), regardless of whether contrary ATC instruction is given prior to, or after the RAs are issued.

BFU: German Federal Bureau of Aircraft Accidents Investigation



# **BFU Investigation Report**

In May 2004 BFU issued the final investigation report on the mid air collision accident.

The Tupolev pilot was found to have responded to ATC instructions that conflicted with the ACAS RA.

Additional Safety recommendations have been released to ICAO, among other things, as follows:

Safety Recommendation No. 08/2004

To enhance the performance of ACAS ICAO should initiate the development of down-linking RAs to ATC, using such technologies as SSR Mode S and Automatic Dependent Surveillance Broadcast (ADS-B)

Safety Recommendation No. 09/2004

To improve the investigation of future accidents and incidents ICAO should require ATS units – in addition to present regulations – to be equipped with a recording device that records background communication and noises at ATCO workstations similar to a flight deck area microphone system.



# ICAO Action-(1)

On June 2003 the council of ICAO approved Amendment 12 to the PANS-OPS for applicability on 27 November 2003. Amendment 12 strengthens provisions concerning:

- 1) the need for pilots to follow resolution advisories (RAs), even if there is a conflict between RA and maneuver instructions issued by ATC;
- 2) the prevention of maneuver in the sense opposite to a RA;
- 3) prompt notification to ATC concerning pilot responses to RA; and
- 4) training guidelines for pilots



# ICAO Action-(2)

 On 30 November 2004 the ICAO sent the State letter requesting comments on the proposals for the amendment of Annex 2, Annex 11 and Annex 13 in light of recommendations made by the BFU.

A proposed Standard for inclusion in Annex 11 is, among other things, as follows:

From 1 January 2010, air traffic control units shall be equipped with devices that record background communication and the aural environment at air traffic controller work stations.

• The State letter also mentions that the feasibility of down-linking of RAs is under review by the Surveillance and Conflict Resolution Systems Panel of the Air Navigation Commission of the ICAO.

# JAA Action

- On March 1, 2005 JAA issued a notice of proposed amendment (NPA) for JAR OPS 1.398 rules that would require pilots to respond to resolution advisories (RAs) from airborne collision avoidance systems (ACAS).
- The comment period on the proposal ends on June 1,2005.

JAA: Joint Aviation Authorities





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