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REPRESENTATIVE OF JAPAN
ON THE COUNCIL OF THE
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15 July 2002

J-37/2002

Subject: Safety Recommendations to ICAO

Dear Mr. Pereira,

I have the honour to transfer a copy of the letter addressed to you from the Chairman of the Japanese Aircraft and Railway Accidents Investigation Commission dated 12 July 2002.

The original of this letter is being sent to you by airmail.

Accept, Sir, the assurances of my highest consideration.

for Akihiro Aoki
Representative of Japan
on the Council of ICAO

Mr. R. C. Costa Pereira
Secretary General
International Civil Aviation
Organization

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KOKU-KUI-CHO No.44

July 12, 2002

Mr. R. C. Costa Pereira
Secretary General
International Civil Aviation Organization
999 University Street
Suite 15.40, Montreal, Quebec
CANADA

Dear Mr. Pereira,

Today, we published the final report concerning the near midair collision accident involving Japan Airlines Boeing 747-400D and Japan Airlines Douglas DC-10-40 which occurred over sea water off the Pacific coast of Shizuoka Prefecture in Central Japan on January 31, 2001. In view of the result of the accident investigation, we believe that the amendments to ICAO documents concerning the operation of Airborne Collision Avoidance System (ACAS) are necessary to enhance the safety of civil aviation and especially to prevent mid-air collision accidents. We, therefore, came to a conclusion to submit the safety recommendation to ICAO in accordance with ICAO Annex 13 Chapter 6 Section 6.9 as attachment A. We hope that this safety recommendation will be fully discussed at ICAO and that the related ICAO documents will be amended accordingly.

As of today, the final report is published in Japanese only. The attachment B is the tentative translation of excerpts of the report. The full English version will be sent to you later as soon as the translation is completed.

Yours sincerely,

Junzo Sato

Junzo SATO, Chairman
Aircraft and Railway Accidents Investigation Commission
Ministry of Land, Infrastructure and Transport
2-1-2, Kasumigaseki, Chiyoda-ku, Tokyo 100-8919
Japan

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Attachment A

Safety Recommendations to ICAO

On January 31, 2001, a near midair collision accident involving two Japanese registered aircraft namely Boeing 747-400D, JA8904 (Aircraft-A) as Japan Airlines scheduled flight No.907 and Douglas DC-10-40, JA8546 (Aircraft-B) as Japan Airlines scheduled flight No.958, occurred over sea water off Yaizu city Shizuoka prefecture. This near-midair collision was a result of Aircraft-A's descent following the instruction given by ATC and disregarding an ACAS RA climb instruction; whereas Aircraft-B descended in accordance with an RA. Though the pilots of Aircraft-B executed evasive maneuvers following the RA and deviated from an air traffic controller's clearance, they notified ATC of the deviation after the conflict was resolved. The Aircraft and Railway Accidents Investigation Commission (ARAIC) of Japan believes that the above mentioned operations had been influenced by some of the description of ICAO regulations related to ACAS operation. This commission, therefore, recommends, in order to prevent reoccurrence of similar accidents and occurrence of midair collisions and to better ensure aviation safety, ICAO to amend these regulations as follows:

1. Amendment of the PANS-OPS to specify explicitly the compliance with an RA and the danger of maneuver contrary to an RA.

Pilots should execute evasive maneuvers keeping the principle that RA's should always be complied, in order to prevent aircraft accidents, whenever the two aircraft are expected to come close to each other.

Learning from this accident experience in Japan, ICAO should amend its regulations related to ACAS operation as follows for ACAS to be operated effectively worldwide.

(1) Amend ICAO Annex 6 or PANS-OPS Volume I Part Ⅷ Chapter 3 "Operation of ACAS Equipment" to put explicitly that pilots should always comply with an RA with a few limited exception. 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 I Part Ⅷ 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 Ⅳ Chapter 4 Appendix A Guidance Material paragraph 3.5.8.10.3.

2. Amendment of PANS-OPS to specify when pilots should inform ATC of deviation from an air traffic control clearance.

It is necessary for ATC to be notified by pilots of the activation of an RA at the earliest time before the conflict is resolved, for the purpose that air traffic controllers are aware of the activation of an RA, and can respond appropriately to such a situation. ICAO, therefore, should amend its regulations related to ACAS as follows:

The current PANS-OPS Volume I Part VIII Chapter 3 says that "Operation of ACAS Equipment" paragraph 3.2 d) that "*pilots who deviate from an air traffic control instruction or clearance in response to a resolution advisory shall promptly return to the terms of that instruction or clearance when the conflict is resolved 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 case that a pilot execute evasive maneuvers following an RA, the notification of deviation to ATC shall be made promptly before the conflict is resolved unless it is difficult to do due to the execution of evasive maneuvers.

Attachment B

Accident Investigation Report Outline Concerning Boeing 747-400D, JA8904

Note: This attachment is the tentative translation of excerpts of the final report.

1. Summary of the Aircraft Accident

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. 16 crewmembers and 411 passengers, total 427 persons were on board.

At this time, Douglas DC-10-40, JA8546, (Aircraft B) flew towards New-Tokyo International Airport to the west of Aircraft A, as Japan Airlines scheduled flight No.958. 13 crewmembers and 237 passengers, total 250 persons were on board Aircraft B.

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.

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 the 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.

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 others path. On that occasion, since Aircraft A made a rapid descent in order to pass under Aircraft B just before crossing, many passengers and CA's (Cabin Attendants) on board Aircraft A got injured.

Number of injured persons were as follows:

Seriously injured persons: Passengers 7, Cabin crew 2, Total 9
Slightly injured persons: Passengers 81, Cabin crew 10, Total 91
Total number of injured persons 100

No person was injured on Aircraft B.

2. Flight History

The flight history obtained from DFDR records, Air Traffic Control Communication records, etc. are as follows;

On 31 Jan 2001, Boeing747-400D, JA8904, (Aircraft A) took off from Tokyo International Airport toward Naha Airport as Japan Airlines scheduled flight No.907 at 1536 (Japan Standard Time, and the following times are also the same) , and was cruising by IFR in accordance with the flight plan.

Total 4 crewmembers, namely the captain sitting on the left forward seat, a trainee for first officer sitting on the right forward seat, a first officer sitting on the left observer seat and a trainee for first officer sitting on the right observer seat, were on board the Aircraft A cockpit.

The flight plan of Aircraft A, which had been filed to the Tokyo Airport Office is as follows;

Flight rule: IFR, Aerodrome of departure: Tokyo International Airport, Planned block out time: 1525, Cruising speed: 497kt, Level: 390, Route: KZE URAGA OCEAN YZ CELLO SAKAK W28 TAPOP G581 ONC NHC, Destination Aerodrome: Naha Airport, Total estimated enroute time: 2 hours and 22 minutes, Fuel load in terms of flight time: 3 hours 52 minutes, Number of persons on board: 415

The flight history near the location of the accident occurrence, shown by DFDR records, Air Traffic Control Communication records, Air Traffic Control radar records and TCAS data recorded by ACMS and AIDS, was as follows:

When this accident occurred, a total of 3 air traffic controllers, namely an air traffic controller trainee (ATC trainee) and an air traffic controller supervisor (ATC watch supervisor) and an air traffic controller at coordination seat, conducted ATC services at Kanto South C sector of Tokyo ACC.

At 1541:16, Aircraft A informed Tokyo ACC to climb to FL390 passing 11,000ft. The ATC trainee responded to this information.

At 1542:12 and 1544:33, the ATC trainee instructed Aircraft A to go direct to YAIZU NDB. Aircraft A responded to comply with this instruction.

At 1545:25, ATC trainee instructed Aircraft A to maintain FL350 till next instruction. Aircraft A repeated this instruction. Meanwhile, the aircraft as American Airlines scheduled flight No.157 (Aircraft C) was cruising at FL390 above the vicinity of Izu Oshima to Kushimoto Wakayama prefecture.

At 1546:38, Aircraft A, that was climbing near FL216, was instructed to climb to FL390 by the ATC trainee. At 1546:41, Aircraft A responded to Tokyo ACC to climb to FL390.

At 1546:51, letters of "HND" was indicated in Aircraft B's data block on the radar display of Kanto South C sector, and flashed on and off, as a result that the neighboring sector handed over air traffic control of Aircraft B to Kanto South C sector.

At 1547:02, the ATC trainee instructed Aircraft C to descend to FL350, because Aircraft A would fly at the same flight level as Aircraft C, but Aircraft C did not respond to Tokyo ACC.

At 1547:14, the aircraft as Japan Airlines scheduled flight No.952 (Aircraft D) requested Tokyo ACC to fly directly to the fix in the vicinity of New Tokyo International Airport, and the ATC trainee instructed Aircraft D to stand by.

At 1547:47, an air traffic controller of Kanto South C sector input the command to RDP (Radar Data Processing System) to receive the hand over of air traffic control of Aircraft B from another sector.

At 1547:56, the ATC trainee called up Aircraft C again, but Aircraft C did not respond.

At 1548:08, the ATC trainee instructed Aircraft D to contact New Tokyo International Airport. At 1548:12, Aircraft D responded to comply with this instruction.

At 1548:14, Aircraft B which was cruising towards New Tokyo International Airport at FL370 in the west of Aircraft A, informed Tokyo ACC that its flight level was 370. At 1548:18, the ATC trainee responded to acknowledge this information.

The ATC trainee continued to communicate with other aircraft.

Total of 3 crewmembers, namely the captain sitting on the right forward seat, a trainee for the captain sitting on the left forward seat and a flight engineer, were on board the Aircraft B cockpit.

At 1548:22, an air traffic controller of Kanto South B sector, who had controlled Aircraft C till that time, instructed Aircraft C to change its radio frequency to that of Kanto South C sector.

At 1548:37, Aircraft C informed Kanto South C sector that its flight level was 390. Therefore the ATC trainee instructed Aircraft C to descend to FL350, because another aircraft was cruising at the same flight level as Aircraft C. Aircraft C repeated this instruction, and responded to leave from FL390.

During a period of 9 minutes from 1543:00 to 1552:00, the ATC trainee controlled 14 aircraft as maximum, and communicated to aircraft a total 37 times under the guidance of the ATC watch supervisor. 18 contacts comprised air traffic instructions. During the above 9 minutes, blanks of communication, which were longer than 15 seconds, were 3 times, and the number of contacts to aircraft were 4 or 5 times per one minute. During a period from 1552:00 to 1554:22 when a series of communications related to this accident started, the ATC trainee communicated 4 times to 3 aircraft, and gave instruction once.

At 1553:50, Aircraft A climbing on heading 270° began to make a left turn, and presently continued climbing while maintaining an approx. 25° roll angle.

At 1554:00, Aircraft B was cruising at FL370 with 095° heading at ground speed 567kt in the west of the location of the near-midair collision. At the same time, the upward arrow showing that Aircraft A was climbing was indicated by the side of the symbol mark of Aircraft A on the TCAS display equipped on Aircraft B.

At 1554:15, CFN was indicated on the radar display of Kanto South C sector of Tokyo ACC. At the same time, the radar screen showed that the flight level of Aircraft A was 367 and flight level of Aircraft B was 370.

At 1554:18, Traffic Advisory (TA), which showed that another aircraft was approaching to Aircraft B, was indicated on the TCAS display equipped on Aircraft B.

At 1554:19, TA was indicated on the TCAS display equipped on Aircraft A. Aircraft A was climbing while making a left turn at FL369, and the ATC radar display showed that flight level of Aircraft A was 369.

Of note, when TA was issued, an approaching aircraft is indicated in "yellow" on the TCAS display, and aural annunciation "TRAFFIC, TRAFFIC" sounded to the cockpit.

From 1554:26 to 1554:29, auto-throttle of Aircraft B, which had been engaged till that time, was disengaged.

From 1554:27 to 1554:32, the ATC trainee instructed Aircraft A to descend to FL350 and to begin descent immediately due to traffic.

At 1554:32, auto-pilot of Aircraft B which had been engaged till that time, was disengaged.

At 1554:33, fuel flow of Aircraft A began to decrease.

From 1554:33 to 1554:38, Aircraft A climbing near FL371 informed ATC to descend to FL350 complying with the instruction given by the ATC trainee, and to recognize the approaching aircraft visually. By the way, according to ATC Communication records, aural annunciation "CLIMB, CLIMB, CLIMB" was recorded in the communications with Aircraft A from 1554:35 to 1554:38.

At 1554:34, pitch angle of Aircraft A began to decrease.

At 1554:34, TCAS equipped on Aircraft B issued Resolution Advisory (RA) advising to execute evasive maneuvers, and advised Aircraft B to descend at -1,500ft/min.

At 1554:34, TCAS equipped on Aircraft A issued Resolution Advisory (RA) too, and advised Aircraft A to climb at 1,500ft/min.

At the same time, Aircraft A was climbing near FL371 while making a turn, and Aircraft B was cruising near FL370 on 095° heading.

Of note, when TA changes to RA, indication of an approaching aircraft on the TCAS display changes from "yellow" to "red", and in case of instruction of an evasive maneuver to climb, the rate of climb is indicated on the TCAS display with aural annunciation "CLIMB, CLIMB, CLIMB" sounded to the cockpit. In case of instruction

of an evasive maneuver to descend, the rate of descent is indicated on the TCAS display with aural annunciation "DESCEND, DESCEND, DESCEND" sounded to the cockpit.

At 1554:37, in a moment, pitch angle of Aircraft A, which had decreased till that time, increased a little, but afterward, it continued to decrease.

At 1554:38, auto-throttle of Aircraft A was disengaged.

From 1554:38 to 1554:41, the ATC trainee instructed Aircraft B to make a turn to 130° for ATC to keep separation. Aircraft B did not respond to this instruction.

From 1554:39 to 1554:43, fuel flow of Aircraft A increased for a moment, but afterward, it continued to decrease.

At 1554:39, auto-pilot of Aircraft B, which had been engaged till that time, was disengaged.

At 1554:43, Aircraft A reached to the top of climb (FL372) while making a left turn, but afterward, altitude of Aircraft A began to decrease.

At 1554:43, altitude of Aircraft B began to decrease.

At 1554:46, roll angle of Aircraft A increased more than 30° to the left in a moment, but afterwards, it began to decrease. Then, Aircraft A began to roll-out slowly on 207° heading.

At 1554:49, TCAS equipped on Aircraft B issued increase RA (instruction to descend at -2,500ft/min). At the same time, Aircraft B was descending at FL369, and Aircraft A was descending at FL370. RA issued by TCAS equipped on Aircraft A advised Aircraft A to climb at 1,500ft/min.

Of note, when increase RA is issued, in case of instruction of an evasive maneuver to descend, the descending rate, indicated on TCAS display, increases with aural annunciation "INCREASE DESCENT, INCREASE DESCENT" sounded to the cockpit.

From 1554:49 to 1554:52, the ATC trainee instructed Aircraft B to turn to 140° heading to keep ATC separation.

Aircraft B did not responded to this instruction. At the same time, Aircraft B was descending near FL369, and Aircraft A was descending through FL370-FL369.

From 1554:51 to 1555:12, flight levels of Aircraft A and Aircraft B changed as follows. (Note; following data include some tolerance.)

Time (15-)	FL of Aircraft A	FL of Aircraft B
54:51	369	369
:52	369	369
:53	368	368
:54	368	368
:55	367	368
:56	367	367
:57	366	367
:58	366	366
:59	366	366

55:00	365	365
:01	365	365
:02	365	364
:03	364	363
:04	363	363
:05	363	362
:06	362	361
:07	362	360
:08	360	359
:09	358	358
:10	357	358
:11	355	357
:12	354	357

At 1554:54, TCAS display equipped on Aircraft A showed that Aircraft B was descending. Descent of Aircraft B was indicated as a downward arrow by the side of the symbol mark of Aircraft B on TCAS display equipped on Aircraft A.

From 1554:55 to 1554:57, the ATC watch supervisor overrode the ATC trainee, and instructed JAL957 to start to descend, but there was no corresponding aircraft in the neighborhood.

From 1555:02 to 1555:05, the ATC watch supervisor instructed Aircraft A to climb to FL390, but Aircraft A did not respond to this instruction. At the same time, RA issued by TCAS equipped on Aircraft A advised to climb at 1,500ft/min, and RA issued by TCAS equipped on Aircraft B advised to descend at -2,500ft/min.

At 1555:05, the descending pitch angle of Aircraft A began to increase. Aircraft B was descending near FL362, angle of the control column changed from pitch down to pitch up. RA issued by TCAS equipped on Aircraft B advised to descend at -2,500ft/min.

At 1555:06, when Aircraft A was descending at FL362, TCAS equipped on Aircraft A issued increase RA (instruction to climb at 2,500ft/min). CAS (Computed Air Speed) of Aircraft A was 284kt, and it was stabilized during descent of Aircraft A, but afterward, it began to increase.

Of note, when increase RA is issued, in case of instruction of an evasive maneuver to climb, the climbing rate indicated on TCAS display increases with aural annunciation "INCREASE CLIMB, INCREASE CLIMB" sounded to the cockpit.

At 1555:07, the pitch angle of Aircraft A became the maximum pitch angle -10.8°. Afterward, it slowly returned to climbing direction.

At around 1555:08, fuel flow of Aircraft A decreased to an idle position. At the same time, Aircraft A was descending near FL360.

TCAS record of Aircraft B showed that increase RA changed to TA at 1555:09. It was because TCAS equipped on Aircraft B could not receive information of Aircraft A

continuously. At the same time, DRP (truck drop), which meant that TCAS data were deleted from TCAS equipment, was occurred. As a result of DRP, the symbol mark of Aircraft A on TCAS display equipped on Aircraft B disappeared, and TA was not issued.

At 1555:10, TCAS equipped on Aircraft B became able to receive information of Aircraft A again, and showed the symbol mark of Aircraft A, but did not issue RA because it was immediately after receiving information of Aircraft A.

At around 1555:11, Aircraft A and Aircraft B passed by each other.

At 1555:13, when Aircraft A was descending near FL353, CAS of Aircraft A became 299kt that was the maximum speed throughout the descent. At the same time, fuel flow of Aircraft A was near idle, and pitch angle of Aircraft A was returned to -5.5°. At the same time, Aircraft B was descending near FL356.

At 1555:15, RA issued to Aircraft A which was climbing at 2,500ft/min changed to TA, and showed that conflict was resolved.

At 1555:18, Aircraft A was descending through FL348, and pitch angle of Aircraft A was becoming to plus value.

At 1555:20, Aircraft A was near FL348, began to climb from 1555:21.

From 1555:21 to 1555:27, Tokyo ACC received notification that RA was issued, this aircraft was descending, and would climb again. Although this notification did not include any flight number, as a result of investigation, this aircraft was identified as Aircraft B. At the same time, Aircraft B was descending near FL353. But, at around 1555:26, Aircraft B began to climb.

At 1555:29, ATC watch supervisor of Tokyo ACC responded "Japan air niner zero ・・・eight, roger.", but there was no corresponding aircraft in the neighborhood.

From 1555:32 to 1555:34, Aircraft A notified of clear of traffic to Tokyo ACC, and ATC watch supervisor responded "roger".

From around 1555:00 when Aircraft A was descending, to around 1555:21 when Aircraft A began to climb again, vertical acceleration of Aircraft A varied remarkably. At 1555:06, it became -0.55G, and at 1555:17, it became +1.59G. Of note, vertical acceleration of Aircraft A was identical to that of its center of gravity.

Aircraft A engaged auto-pilot and auto-throttle again. And Aircraft A notified to Tokyo ACC that a near-midair collision with a DC-10 occurred, and requested to turn back to Tokyo International Airport since some passengers were injured. This request was authorized by Tokyo ACC.

Aircraft A landed at the airport at 1644.

Aircraft B, after passing by Aircraft A, continued cruising with engaging auto-pilot and auto-throttle again. At 1632, Aircraft B landed at New Tokyo International Airport.

3. Probable Causes

The accident was caused as follows:

When Aircraft A (Japan Air Lines flight 907) was making a left turn climbing and Aircraft B (Japan Air Lines flight 958) was cruising Level, CNF (Conflict Alert) was generated at Tokyo ACC, warning that these aircrafts were coming to proximity. Tokyo ATC mistook the flight number of Aircraft B for that of Aircraft A, and issued an instruction to Aircraft A, which was climbing then, to descend.
Aircraft A responded to this instruction and initiated a maneuver to descend. Immediately, its TCAS (Traffic Alert and Collision Avoidance System) issued RA (Resolution Advisory) to climb, but Aircraft A continued the maneuver to descend complying with the ATC instruction. While both Aircraft B which descended in response to its TCAS RA and Aircraft A kept the other traffic in before crossing, both aircraft made evasive maneuvers to avoid a collision based on visual judgement. During this maneuver Aircraft A made an abrupt descent intending to pass under Aircraft B, and passengers and cabin attendants of Aircraft A were tossed, floated, fell and sustained injuries.

The ARAIC considers that the following factors affected the cause of the accident:

(1) As to the Tokyo ATC's instruction of descent which they mistakenly issued to Aircraft A instead of Aircraft B: the ATC trainee and ATC watch supervisor were controlling the heavily loaded traffic of Kanto South C sector. When the conflict alert was generated, they became upset under the psychologically pressing situation and the ATC trainee issued an instruction to an unintended aircraft by mistake. The ATC watch supervisor did not notice the ATC trainee's mistake of flight number in instructing the descent. When Aircraft A read back to the ATC instruction, both the ATC trainee and the ATC watch supervisor did not notice that the flight number in the readback was different from the intended one.

(2) As to the upset of the ATC trainee and ATC watch supervisor when the conflict alert was issued: They had forgotten the presence of Aircraft B when CFN was issued. CFN was not issued at the specified time of three minutes before standard separation would be lost, and was issued two and a half minutes later than that. It was about one minute before the closest point of approach. At that time, to maintain standard separation became extremely difficult, so they felt pressured into issuing instructions urgently to avoid a near collision within a limited time length.

(3) As to the circumstance that the ATC trainee had forgotten the presence of Aircraft B: As Aircraft C (American Airline flight 157) was flying at the flight level that was

approved to Aircraft A and both aircraft were on converging flight paths, the ATC trainee called up Aircraft C twice to issue an instruction to secure a separation between Aircraft A and Aircraft C. But he received no response from Aircraft C because he had not established a communication with the aircraft. It was when his attention had been directed to Aircraft C that he conducted a radar hand off of Aircraft B and established a communication with Aircraft B. Other events that made it difficult to keep Aircraft B in his memory was that he made a communication with Aircraft D (Japan Air Lines flight 952) whose flight number was similar to Aircraft B just before he established the communication with Aircraft B, and that he continued communicating with another aircraft without pause thereafter. Furthermore, while he received comments later by the ATC watch supervisor on the ATC works performed until then, he did not check the traffic situation on the radar display.

(4) As to the circumstance that the ATC watch supervisor had forgotten the presence of Aircraft B: She was coordinating with a neighboring sector on the separation of Aircraft A and Aircraft C and her attention was directed to getting contact with Aircraft C. She gave comments to the ATC trainee on the ATC works performed until then when she should have checked the traffic situation on the radar display, and remained unaware of the presence of Aircraft B. She had not received any education and training on appropriate training methods for training supervisors.

(5) As to the circumstance that the conflict alert was not issued at the specified time of three minutes before standard separation would be lost: The Air Route Radar Data Processing System did not have the function to search the possibility of losing a separation taking account of changing courses of aircraft.

(6) As to the circumstance that Aircraft A did not comply with RA indicating to climb: Since the captain of Aircraft A had already initiated a descending maneuver in accordance with the ATC instruction to descend when RA was issued, it was difficult psychologically for him to change the action which he had already started.

(7) As to the circumstance that Aircraft A continued descending: It was difficult for flight crew members of Aircraft A to understand the altitude difference with Aircraft B and to recognize accurately the movement of Aircraft B that was descending. They recognized insufficiently about the danger of maneuver opposite to the RA indication. Their situation awareness by utilizing TCAS information displays was insufficient. The flight crewmembers other than the captain did not give any appropriate instruction indicating to comply with RA to the captain.

(8) As to the circumstance that the captain of Aircraft A recognized insufficiently the potential danger to maneuver opposite to the RA indication and that the flight crew

members other than the captain did not give any appropriate instruction indicating to comply with RA to the captain: The expression of the manuals for operation provided by the operator had been insufficient to have flight crew recognize the danger of maneuver opposite to RA. The education and training about TCAS for flight crew had been insufficient. Training to perform the assigned role corresponding to TCAS operation had not been conducted during CRM training.

(9) As to the insufficient expression of the manuals for operation provided by the operator to have flight crew recognize the danger of maneuver opposite to RA: The importance to comply with RA and the danger of maneuver opposite to RA were not specified in AIC (Aeronautical Information Circular) issued by Civil Aviation Bureau and ICAO documents for aircraft operation. Especially, it was not specified that RA should be complied with when ATC instruction and RA were issued simultaneously and both conflicted with each other.

(10) As to the injuries to the passengers: There were many passengers who had not fastened their seat belt and many of their bodies were tossed and fell due to the aircraft movement since the accident occurred at the time when the seat belt signs were turned off and the cabin service had just begun. As for the injured passengers who had fastened their seat belt, the way to fasten their seat belt was improper, or they were hit by persons who were tossed when those persons fell onto the floor.

(11) As to the injuries to CA's: They could not stop the movement of galley carts, and were tossed, floated and fell with galley carts since they were at cabin service and had no sufficient time to return the galley carts to the galley at the time of aircraft movement. They had no means to support their bodies due to the sudden aircraft movement.