



**General Administration of Civil Aviation of China**

**Comments on KAIB Aircraft Accident Report (Draft)**

**Aviation Safety Committee of CAAC**

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## Comments on KAIB Aircraft Accident Report (draft)

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## **1. Factual Information**

### **1.8 Aids to Navigation**

#### **1.8.2 Airport Lighting**

According to the original records of the airport lighting, when CA129 was circling approach, approach light and circling guidance light on runway 18R was turned off. An automatic recording system is installed in the Gimhae Airport lighting control room to calculate the lighting fee. The timing clock within the computer system automatically calculates the time used for lighting. It was said the timing clock within the computer system was reset 19 minutes back at 20:30 on 18 April.

According to the tower controller's statement at the public hearing, the runway approach and circling guidance lights of the runways 36L and 18R were turned on when CA129 was approaching. But, when the captain of CA129 being interviewed, he stated there was no circling guidance lights in sight. During the public hearing, the captain also testified that he could see the approach light of 36L during approach, and on the downwind leg of circling approach, he could clearly see the runway, but did not see any lights.

### **1.10 Airport Information**

#### **1.10.2 The Circling Approach Procedure of Gimhae Airport**

When using runway 36L under instrument meteorological conditions, the aircraft follows ILS or VOR/DME procedure to have the straight-in approach. When using the runway 18R, the aircraft has to use straight-in approach procedure of runway 36L to descend to the MDA of circling approach, and after having the runway in sight, apply circling approach to land.

Gimhae Airport local procedure prescribes that the tailwind wind limit for landing at the airport is less than 10 knots. At Gimhae Airport, southwestern winds prevail during spring and summer, and the circling approach to the runway 18R was frequently applied. In the abnormal operation recordings, there were some occasional miss approaches when circling approach failed.

#### **1.10.3 General Operation Information of Gimhae Airport**

Gimhae Airport is an airport jointly used by military and civilian, and the military is responsible for weather observation, weather forecast and air traffic control. There are averagely 32 international flights, 131 domestic flights per day.

The air carriers operating in this airport are: Air China, China Eastern, China Northwestern, China Northern, Korean Air, Korean Asia Airlines, Japan Air, US Northwest Airlines, Some Russian Airlines etc. The types of aircraft operated there are B777, B767, B737, A300, A310, A320, A330, MD90, MD82 and FK100 etc.

#### 1.10.4 Abnormal Operation Condition on the Day prior to the Accident

Flight /Type	Local time	Description	Reason	Supplement
KAL1103 A300-600	08 : 08 —08 : 50	Failed to circling app twice, hold for 9min, alter to RKSS	Runway not in sight	ceiling : 1500ft , vis : 3miles MDA : 1100ft
AAR8803 A321	08 : 15 —08 : 36	Failed to circling app, hold for 15min Radar displayed the ground speed on downwind leg was 180 knots	Runway not in sight on base leg	Crew informed other flights in Korean that cloud was on the base leg. MDA:700ft
KAL662 A330-300	08 : 24 —08 : 52	Failed to circling app. Alter to Incheon	Runway not in sight on base leg	Controllers informed the obstacle with Korean language. MDA:1100ft
KAL818 A330	08 : 26 —09 : 05	Hold at KACHI and alter to Incheon	Poor weather condition at the airport.	Not conduct the circling approach
KAL1105 A300-600	08 : 31 —09 : 04	Failed to circling app, hold for 15min and alter to Incheon	Runway not in sight on downwind leg	Ceiling 1000ft ; VIS : 2.5miles ; below D,E landing minimum ; MDA : 1100ft
AAR8533 A321	08 : 36 —09 : 21	Failed to circling app, hold for 18min and alter to Daegu Radar displayed the ground speed on downwind leg was 180-200 knots	Runway not in sight on base leg.	MDA: 700ft
KAL1109 A300-600	08 : 39 —09 : 23	Hold for 30min and alter to RKSS	Poor weather condition at the airport.	Flow control by the RAPCON
KAL1000 A300-600	08 : 39 —09 : 23	Alter to Daegu	Poor weather condition at the airport.	Required the weather condition to the Gimhae

#### 1.10.5 Weather Observation

According to the agreement signed between the ROK Air Force Gimhae Base Weather Office and Gimhae Civilian Weather Station of the Meteorological Department, the ROK Air Force shall be responsible to provide the weather observation and weather forecast service for the Gimhae airport, the applicable service standards of the ROK Air Force shall be implemented. The duty of Gimhae Civilian Weather Station is to collect the weather

information provided by the Air Force with the civil meteorological report format and issue it to the civil airlines.

#### **1.10.5.1 Visual Weather Observation Site**

The visual weather observation site of the Gimhae Airport Weather Office is located on rooftop of the Air Force weather office. A hangar in the north blocked the observation view and the views toward the lower skies north and northwest of the Gimhae Airport (including the site where the accident occurred) were blocked. The weather observer from the Gimhae Air Force Weather Office stated that when making the observations of this part of the sky, the observers have to leave the observation platform for the apron west to weather office, at a distance which required five minutes round trip on foot between the weather office and the apron observation site. The weather observation post was constructed in December 1971, and maintenance hangar was built in December 1990. There was no blockage to the views toward the north approach area direction of the Gimhae Airport before construction of this hangar.

#### **1.10.5.2 Weather Observation Equipment**

The automatic weather observation system located along the east runway of the Gimhae airport was installed in December 28th, 1990, and put into service since March 23rd, 2000. The system consists of an anemometer, instrumentation for measuring temperature and dew point, rain gauge, barograph, laser beam ceilometers and RVR (runway visual range) measuring equipment. At the time of the accident, all the equipment recorded normal operation.

The RVR measuring equipment had stopped to provide service (Notice to Airman had been issued) on July 12, 2002. And at the time of the accident, it was still in the unserviceable state, and only the equipment itself was still in the “on” state, and recorded a value measured.

### **1.16 Test and Research**

Since both the Chinese and Korean Investigating Teams have different opinions on the first transfer instruction given by Gimhae approach controller, the Chinese investigation team had 10 controllers and 8 pilots to listen to the clearance “Air China 129, Contact Tower one eighteen point one, Circle to...”. The result was that none of them could identify it.

### **1.18 Other Information**

#### **1.18.1 Information on Special Airports**

Korean 《Flight Safety Regulations》<sup>1</sup>, Article 517 and 518 stipulates: Special airports are divided into class A, class B and class C. Among them, Gimhae airport is defined as class A<sup>2</sup>

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<sup>1</sup> Formulated in accordance with the 《Korean Aviation Law》 Article 74-2.

<sup>2</sup> Requirements on class A airport:

because of high terrain north and east to the airport. Therefore requirements on flight experience and training are stipulated for a captain who flies to this airport.

This information had not been published to the public, nor notified to CAAC and Air China.

Air China did not list Gimhae airport as a “special airport” in its operation specifications, so neither special training was conducted nor special requirements on flight experience was required.

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No takeoff and landing is allowed when the ceiling is lower than 1000 feet above the minimum enroute altitude (MEA), or minimum obstacle clearance altitude (MOCA), or initial approach altitude, and visibility is less than 3 miles.

In the last three months, the captain must have the takeoff and landing experience as an observer.

The captain must be trained and qualified in the audio-visual training equipment, which is approved by the minister.



## **2. Analysis**

### **2.1 General**

The three flight crew members were certified and qualified in accordance with the ICAO standards, CAAC regulations and the requirements specified by Air China. They had had sufficient rest prior to the flight, and no physical conditions that were not fit for their duty were found. The flight operation within the Korean airspace was in accordance to the Korean Aviation Regulations.

The aircraft had been certified airworthy in accordance with the ICAO standards, CAAC regulations and the requirements specified by Air China. It was properly equipped and serviced by maintenance. There was no evidence of malfunctions with the airframe, the flight controls or the engines prior to the accident. The aircraft had been loaded properly within the limitations of weight and balance.

This section analyses the weather factors at the time of the approach, weather observation, flight crew and controller performance, utilization of equipment and nav aids by air traffic control, related flight procedure and navigation data, etc.

### **2.2 Weather Factors**

#### **2.2.1 Weather conditions**

On the date of the accident, the Gimhae Airport was in a southwest warm & wet airflow, which was located before the cold front and behind the subtropical anticyclone. It was covered by stable precipitus, which caused a long-playing mass of low clouds and bad visibility, and the south wind increased gradually.

According to the airport weather observation at 08:00: the wind direction/wind speed was changed from 140°/ 4knots to 200° /9knots; and the scattered (SCT) cloud base was reduced from 1000ft to 800ft. At 09:00 the weather observation was reported the wind speed increased to 11knots, and the broken (BKN) cloud base was reduced to from 1500ft to 1000ft. At 09:43, there was a special report: the wind speed further increased to 12knots.

At 11:11: the Gimhae Airport weather observation was reported: wind direction/wind speed was changed to 210° /10 knots; and visibility 4000 meters, with light rain and mist, 500ft scattered (SCT), 1000ft broken (BKN); 2500ft overcast (OVC).

At the time of the accident, the wind direction/wind speed recorded in the Gimhae Airport automatic weather observation system had been 210°/13knots; and maximum gust speed 17knots.

While the flight CA 129 was flying on the downwind leg, the wind speed recorded on the flight data recorder (FDR) was 25 knots. The first officer said: “The wind is too strong, it is difficult to fly”.

It can be seen from the above that the weather on the day of the accident at the Gimhae Airport was so bad for circling approach. Before to the accident of CA129 occurred, eight aircraft had landed the alternate airport due bad weather condition, among them, five aircraft executed go-around after failed circling approach to runway 18R.

### **2.2.2 Meteorological Observation**

World Meteorological Organization 《Guide to practices for meteorological offices serving aviation》 (WMO-No.732) 6.2.1.1 stipulates, “The observing office should be sited so as to provide an unobstructed view of the weather conditions over the aerodrome and its immediate vicinity from the observer’s working position, .....

Federal Aviation Administration (FAA) 《Air Traffic Control Facilities Management》 (Order 7210.3), Part I 2-9-7 stipulates: “.....to give a proper indication of weather conditions in the areas of aircraft approaches, landings, and takeoffs, the site..... the site shall also have an essentially unobstructed view of : a. the most frequently used instrument runway and its final approach area; and b. at least half of each quadrant of the natural horizon.”.

At Gimhae Airport, southwestern winds prevail during spring and summer. Aircraft more frequently use the runway 18R for circling approach. According to the above regulations and the meteorological characteristics at Gimhae airport, the observer should be able to continuously monitor the weather change in the maneuvering area for circling approach of runway 18R without any obstructions. However, the north sight field of visual weather observation post was obstructed due to the presence of large hangars, blocking the observer’s direct view of sector for circling approach to runway 18R, so there was possibility to cause the observer to be unable to timely discover the weather change in the north, and it would have an adverse affect on performing a special observation and report<sup>3</sup>. Although the observer could left the observation platform and walk to the apron to observe the blocked area, it would have been considerably inconvenient for the observer to do so, and unable to ensure the observation and report without delay.

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<sup>3</sup> The special observation and report is an observation and report between the two routine observation reports or after the previous special observation report, which is made in the time when the weather change has relatively great affect on the flight. For the details, see Annex 3 to the Convention on International Civil Aviation 《Meteorological Service for International Air Navigation》 .

### 2.3 Flight Crew Performance

As directed by the Gimhae Airport approach controller, CA129 had made the ILS approach to runway 36L, and then circling approach to runway 18R. The minimum of circling approach for category “C” was applied, which was ceiling 700 feet, visibility 3.2km. When the aircraft approached to runway 36L, the flight crew use autopilot (A/P) mode to conduct the instrument landing system (ILS) approach. When decent to 700 feet, the crew reported the runway in sight, then disconnected the autopilot, manually flew the aircraft to turn to downwind leg of runway18R, but thereafter, the following abnormalities happened:

The circling approach operation procedure recommended in the Air China B767 training manual is: at the phase of instrument flight straight-in approach, use the localizer (LOC), vertical speed (V/S). If the Approach (APP) mode is used for the straight-in approach, when turning to downwind leg, the correct operation procedure for this should be: disconnected the autopilot, turn off both flight directors (F/D), and turn on again, then use the heading selector (HDG SEL) to adjust the target heading and use manually control to fly the aircraft away from the course towards downwind leg. The recordings in the flight data recorder (FDR) showed when CA129 flight crew had disconnected the autopilot to turn left using a left bank angle, they did not turn off and turn on again the flight directors (F/D), the flight director were still set in approach (APP) mode, and the flight directors (F/D) gave a right turn indication relative to the left bank angle. As the flight directors provided an opposite indication, it probably required the flight crew to make judgment, thus causing a lag in the flight maneuver. During the time from starting to fly the aircraft to turn left and thereafter, the left bank angle was only up to 5-15 degree (the normal value is 25 degree), resulting in a delay in time for turning the aircraft to heading 315 degree to intercept downwind leg , so that in the time when near passing abeam the threshold of runway 18R, it turned back to the downwind leg heading. Because turning to the downwind leg was made using a bank of less than the normal bank, and the adverse influence of wind direction and wind speed of 210/17 knots, when passing abeam the threshold of the runway, the aircraft was located at position with 1.1 nautical miles of downwind width, which was 0.3 nautical miles narrower than the normal downwind width. The Chinese team believes: As CA129 used the operational procedure not recommended by the manual and thus made the flying more difficult, resulting in the delayed entry onto the downwind leg and the narrow traffic pattern.

According to the normal control procedure, when CA129 reported the runway in sight, the approach controller would transfer the aircraft to the tower controller. But due to the fact that at this time, the approach controller’s voice of the frequency change instruction he issued “Air China 129, contact tower, one eighteen point one, circle west, ...” was difficult to identify, and the phrase to read the frequency was not standard, the flight crew only read back: “Circling, circling, 18R, CA129”and did not read back the frequency transfer clearance to contact tower. The approach controller did not point it out and make correction. Judged by this, the flight crew did not get the transfer clearance of contacting the tower and tower frequency. The controller thought the flight crew would have established contact with tower as instructed, but in fact, the flight crew didn’t. This resulted in an interruption of the controlling for 1 minute 8 seconds. When the flight crew established contact with tower, the actual position of the aircraft was already abeam the threshold of runway 18R. During the

remaining time, the instructions issued by the tower controller significantly increased the workload of the flight crew.

The deviation from the normal flight procedure and interruption of the air traffic control had a potential affect on the subsequent flight of CA129.

When aircraft passing abeam the threshold of runway 18R, the timing of flight crew is correct. Probably it was because that the captain had considered the affect of the tail wind, at 11:20:15,13 seconds after the timing, he directed the first officer who was flying the aircraft at that time, to make base turn. It was also probably because the captain thought it was on the final phase of flight, so he took over the aircraft from the first officer to fly by himself. The first officer might have already realized the necessity for a quick base turn, at 11:20:24, he urged to caution the captain: "Turn quickly, not too late". But immediately afterwards, at 11:20:25, the tower controller issued the landing clearance which last 9 seconds, including the tongue slip "Cleared to land, runway 36L. correction ...". Due to this instruction, the captain failed to respond to the first officer's reminding, "Turn quickly" for base turn. According to the testimony of the captain, it was confirmed that the captain had been distracted at the time by the above clearance from the tower controller.

The Chinese team believes: a judgment had to be made before the captain had not fully understood the real meaning of the controller's instruction, as a result, the flight was adversely affected and failed to decisively fly the aircraft to the base turn. And it is also an objective fact that the time of issuing the landing clearance by the controller and tongue slip in the instruction had caused an adverse influence on the captain to fly the aircraft to base turn.

Another factor that caused the extended downwind leg was high ground speed of the aircraft. CA129 made ILS approach to runway 36L and circling approach to runway 18R according to the speed and altitude of approach category "C". In accordance with the criteria of the procedures, in a calm condition, the indicated air speed when aircraft passing abeam the threshold of runway 18R should not be greater than 140 knots, and the actual timing of the base turn should depend on the current wind direction and wind speed so as to keep the flight track of aircraft within the safety obstacle clearance protection area of the procedure, (with the landing runway threshold as center, the radius is 1.7 nautical miles for Category "C"). But, according to data recorded in the flight data recorder (FDR), the indicated airspeed when aircraft passing abeam the end of runway 18R was 158 knots, and the ground speed up to 177 knots.

Due to the above causes, the position where CA129 actually enter the base turn was 1.1 nautical miles beyond the protection area for TERPS Category "C" at Gimhae Airport.

On the day of the accident, due to the adverse affect of sea fog from the south and strong southwest wind, there was amass of low cloud and fog on the mountainous north of the Gimhae Airport and persisted a long time around there. During the second half of base turn, CA129 actually entered the cloud. Under the circumstances that visual contact with runway and any visual references on ground were lost and the first officer cautioned: "Must go

around”, the captain didn’t execute the missed approach procedure, still attempted to make the final turn to runway 18R. Although the crew might have been aware of obstacles in front of them, and the first officer yelled “Pull up, pull up”, the captain did a pull up action, but it was too late. As a result, the aircraft was impacted with mountain.

## **2.4 Air Traffic Control Factors**

### **2.4.1 Transfer Instruction of Approach Controller**

After the flight crew reported the runway in sight, the approach controller instructed CA129 to change the radio frequency to the tower frequency, but the second officer did not read back the entire instruction, and the approach controller did not correct it. The flight crew did not change the frequency to contact the tower, and then approximately one minute and eight seconds later, the approach controller directed the second time for the same change to the tower frequency.

According to the ATC records, after the approach controller had issued the frequency change instruction for the first time, the flight crew didn’t read back this instruction, and the recording recorded in the cockpit voice recorder (CVR) showed no exchange about crosscheck content of frequency change among crewmembers. In the interview and public hearing, the captain of CA129 stated that in his memory, the flight crew had received the frequency change instruction until at the position of downwind leg.

The Chinese investigation team believes: The reason for CA129 flight crew’s failing to timely change to tower frequency was that the crew had not received the first frequency change instruction.

After repeatedly listening to and analyzing the ATC recordings and the cockpit voice recorder (CVR), the Chinese investigation team believes that the frequency change instruction of the approach controller is really too unintelligible for identification, and the controller used non-ICAO standard frequency phrases. In February 2003, at the invitation by the Korean side, the Chinese and Korean investigation team again listened to questionable contents of ATC recordings and the cockpit voice recorder (CVR) in the lab of the US National Transport Safety Board (NTSB), the American participants also agreed on the conclusion that the frequency change instruction was unintelligible. In May 2004, the Chinese investigation team asked 8 pilots and 10 controllers to listen to the contents of the instruction in the CVR respectively, but no one could identify this frequency change instruction.

The Chinese investigation team believes that the unintelligible frequency change instruction of the approach controller had caused CA129 flight to contact tower too late. And the delay in contact with the tower led to the communication between the tower controller and the flight crew to be concentrated in the critical phase of circling approach, which significantly increased the workload of the flight crew.

## **2.4.2 Communication of the Tower Controller**

After CA129 had established contact with Gimhae tower, the controller asked CA129 first time to report the base turn, the flight crew replied: “Roger”. According to the cockpit voice recorder (CVR), the first pilot said at 11:20:24:” Turn quickly, not too late”, but just in that time, the tower controller issued landing clearance with mistaken contents for over 9 seconds. In the interview, the captain stated: “As the tower was giving us the instruction, and we were concerned with the instruction, so we were unable to check time”. In the public hearing, the captain made the same statement again.

The Chinese investigation team believes: The landing clearance of the controller interfered objectively the operation of the flight crew to enter the base turn, which was one of the causes to have CA129 to extend the downwind leg and fly the aircraft into mountainous area.

According to the regulations specified in Chapter 4 Paragraph 8 ‘Precautions for Radio Communication’, ROK Air Force textbook 《Air Traffic Control Management》 (5-345): “When aircraft is in the final approach, touchdown, landing run, missed approach and initial takeoff ascending phase, it is the time that needs a pilot to concentrate his mind. Therefore, the controller should minimize all the communications as much as possible, provided they are not necessary control instructions. However, it should be ready to issue the information that has affected on safety of aircraft, such as to confirm or notify the airport conditions”.

After issuing the landing clearance, the tower controller had not issued any direct safety alert to CA129, and on the contrary, four times communications irrelevant to the safety alert were made with the flight crew, which distracted the crew’s attention. If the controller had thought it was necessary to communicate with the flight crew, he would have cautioned the crew to watch carefully the mountainous terrain, or to issue a direct safety alert.

The Chinese investigation team believes: The four times communications made after the tower controller issued the landing clearance are in violation to the above regulations, these unnecessary communications interfered objectively the flight crew in flying and decision making in the final approach portion.

## **2.4.3 Automatic Terminal Information Service (ATIS)**

Automatic terminal information service at Gimhae airport is recorded on the spot by the approach controller himself, but the tone quality was poor because of no sound insulation. This interfered the understanding of the weather conditions on that day. In flight, crew complaint “I can’t hear it clearly, I can’t hear it clearly at all ” and “ the voice is too poor”.

## **2.4.4 Utilization of Radar**

### **2.4.4.1 Control Radar at Gimhae Airport**

The control radar at the Gimhae airport had the Minimum Safe Altitude Warning (MSAW) function, but only with visual warning function, not with aural warning function.

Annex 11 to the Convention on International Civil Aviation, Para. 3.9 stipulates: “Radar systems should provide for the display of safety-related alerts and warnings, including conflict alert, conflict prediction, minimum safe altitude warning and unintentionally duplicated SSR codes.”

ICAO 《Procedures for Navigation Services - Air Traffic Management》 (PANS-ATM, Doc 4444), Para. 15.6.4, note 2 provides: “ In the MSAW function, the reported levels from transponder-equipped aircraft with Mode C capability are monitored against defined minimum safe altitudes. When the level of an aircraft is detected or predicted to be less than the applicable minimum safe altitude, an acoustic and visual warning will be generated to the radar controller within whose jurisdiction area the aircraft is operating. ”

The Chinese investigation team believes : Since the Minimum Safe Altitude Warning (MSAW) of the control radar at the Gimhae airport was not provided with aural warning function, no proper warning was provided to the tower controller in this accident and the radar failed to perform its real MSAW warning function.

### **2.4.4.2 Gimhae Approach Control**

According to the provisions of FAA Air Traffic Control Order 7110.65M5-1-13, the radar service should not be terminated until the aircraft conducting instrument approach lands.

ICAO Document 4444, Para.8.6.6.1 states: “An identified aircraft observed to deviate significantly from its intended route or designated holding pattern shall be advised accordingly. Appropriate action shall also be taken if, in the opinion of the controller, such deviation is likely to affect the service being provided.

ICAO Document 4444, Para.15.6.4.2 stipulates: “In the event an MSAW is generated in respect of a controlled flight, the following action shall be taken without delay: a) if the aircraft is being provided with radar vectors, the aircraft shall be instructed to climb immediately to the applicable safe level and, if necessary to avoid terrain, be given a new radar heading; b) in other cases, the flight crew shall immediately be advised that a minimum safe altitude warning has been generated and be instructed to check the level of the aircraft.

At 11:20:47, the approach controller reminded the tower controller that CA129 was likely to go around. From this, it can be judged that after transferring the CA129 to the tower controller, the approach controller was still keeping on radar monitoring. According to the radar record, MSAW warning appeared at 11:20:41 and 11:20:47. From the radar, the approach controller found that the downwind leg of CA129 was already longer than the

normal, so subjectively thought that CA129 was likely to go around and reminded the tower, but he didn't tell the tower about appearance of MSAW warning concerning CA129. With no response received from the tower controller, and MSAW warning appeared for 3 times successively on the radar display at 11:21:09, 11:21:15 and 11:21:16, the approach controller did not continue to remind the tower controller to alert CA129.

The Chinese investigation team believes that, if the approach controller had timely issued an alert of being lower than the minimum safe altitude to CA129 when MSAW warning displayed appeared on the radar display for the first time at 11:20:41 (36 seconds before the accident), it would have been very possible to avoid the accident.

In the public hearing, the Air Force ATC department of Gimhae airport replayed a video about appearance of MSAW warning on the Gimhae radar display, so as to explain that false MSAW warnings often appeared in the daily ATC operation due to limitation of MSAW functional setting of radar system. The Chinese investigation team believes, the MSAW function in the control radar is an important measure to prevent aircraft from impaction with ground obstacles, the controllers should pay great attention to MSAW warning and should be able to distinguish real warnings from false warnings, and timely issue safe alert to aircraft according to MSAW warning. It is wrong not to pay close attention to MSAW warning using frequent appearance of false warning as an excuse.

#### **2.4.4.3 Gimhae Tower Control**

ICAO Annex 11, Para. 2.2 states , “The objectives of the air traffic services shall be to: ...b) prevent collisions between aircraft on the maneuvering area and obstructions on that area;...d) provide advice and information useful for the safe and efficient conduct of flights.”

ICAO Document 4444, Para. 8.4.1 stipulates, “Where suitable radar systems and communication systems are available, radar-derived information, including safety-related alerts and warnings such as conflict alert and minimum safe altitude warning, should be used to the extent possible in the provision of air traffic control service in order to improve capacity and efficiency as well as to enhance safety.”

ICAO Document 4444, Para. 8.10.1 also stipulates, “...surveillance radar may be used in the provision of aerodrome control service to perform the following functions: a) radar monitoring of aircraft on final approach; b) radar monitoring of other aircraft in the vicinity of the aerodrome...d) providing navigation assistance to VFR flights”

On the day of the accident, visual monitoring of the aircraft was difficult, and the use of radar would be helpful to monitor the aircraft. Prior to the accident, there had been 5 Korean aircraft, which executed going around during circling approach to runway 18R. Among them, one A330 was cautioned by the tower controller using Korean language when flew into the north mountainous area. The Chinese investigation team infers that the tower controller determined the location of the aircraft with reference to the radar. But, when it was unable to visually monitor CA129, none of the 5 duty personnel used the radar to monitor the aircraft.



At 11:20:47, the Gimhae approach controller informed, by intercom, the tower of that CA129 was likely to go around. But this important information didn't draw attention of tower controller, and none of controllers referred to the tower radar according to this information. They still attempted to visually search aircraft, and even worse, they did not timely provide this important information to CA129, nor issued direct safety alert. At 11:20:32, the figure 1-2 in KAIB report showed that CA129 had already flown outside the protection area of circle approach of TERPS category "C" aircraft and MSAW warning appeared on the tower radar display for several times.

The Chinese investigation team believes, under the condition that the tower controllers were unable to make visual contact of CA129, because the radar had not been used to monitor the aircraft, they lost the opportunity of directly providing a warning to CA129 and the possibility of avoiding the accident.

## **2.5 Flight Procedure**

### **2.5.1 Circling Procedure of Gimhae Airport**

The FAA 《Terminal Instrument Procedure》 (TERPS) standards was used for design the circling procedure of Gimhae Airport, with which the protection area for Category "C" aircraft was 1.7 NM (3.2km) from the runway threshold, the published minimum descend altitude (MDA) was 700ft; And the circling protection area for Category "D" aircraft was 2.3 NM (4.3km) from the runway threshold; the published value of the MDA was 1100ft.

TERPS criteria and ICAO standard (included in 《Procedures for Air Navigation Service-Aircraft Operations》 (PANS-OPS Doc 8168) are greatly different in the design of circling protection area. The protection area of the former is far smaller than that of the latter. Should the ICAO standard be applied, the circling protection area for Category "C" aircraft would be 4.23 NM (7.85km) from the runway threshold; MDA would be 2400 feet.

The aircraft crashed at a point 4.6 km form the runway threshold with true azimuth of 354°, which was outside TERPS Category "D" protection area but inside ICAO PANS-OPS Category "C" protection area.

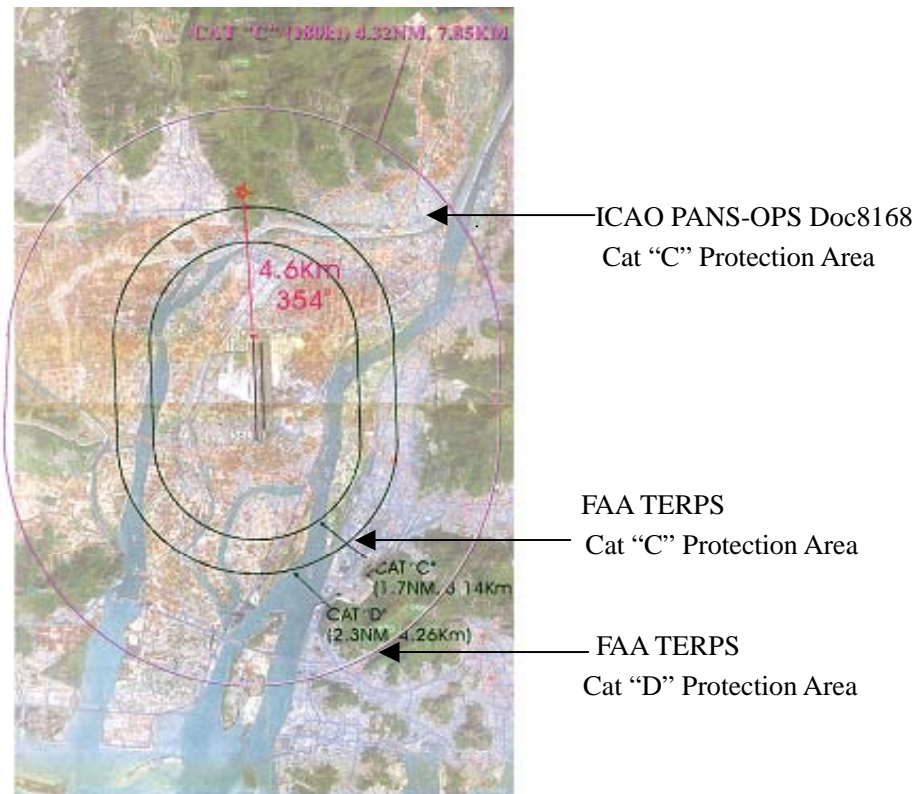


Figure 1 Relationship between aircraft crashed site and circling protection area

It is difficult for pilots and controllers to understand and distinguish the difference between these two criteria, particularly when the two criteria are applied simultaneously in one country without a clear and definite explanation.

## 2.5.2 Aeronautical Information

### 2.5.2.1 AIP ( Aeronautical Information Publication )

The information used by the controller at the Gimhae Airport was from the Korean AIP.

As a national formal aeronautical information document, the AIP is the basis for foreign airlines operating in that state. The main differences between the national regulations and ICAO recommended standards, measures, and procedures should be included in AIP. Annex 15 to the Convention on International Civil Aviation requires claiming the “criteria on which holding, approach and departure procedures are established. If different from ICAO provisions, the requirement is for presentation of criteria used in a tabular form”.

In Para. 1.17 of the ROK AIP, it only stated “Aircraft Operation (ICAO Doc8168) is applied to construction procedure for instrument flight procedure. However, United States Standard for Terminal Instrument Procedure (TERPS 8260.3) may be applied in a case that the establishment of instrument flight procedures is impossible by the application of ICAO regulations concerned because of ground obstacles, limitation of airspace utilization and so on”. But, no specific operation conditions were pointed out, causing the operators difficult to specifically understand which airport of Korea and which procedure used TERPS criteria as

well as the concrete contents of the TERPS criteria. The ROK AIP did not specify as required by Annex 15 the main differences<sup>4</sup> of standard used for the Gimhae Airport flight procedure design from the ICAO standard.

In the Korean AIP information, there is no description on the design standard of Gimhae Airport flight procedure; it is impossible to know that the Gimhae Airport is designed according to the TERPS criteria. In the AIP approach chart, there was only distinctive mark for aircraft types, but no note on aircraft speed.

The Korean AIP chart had no relief and contour shown in brown color as required by ICAO Annex 4. See Figure 1-10 of KAIB report.

### **2.5.2.2 Jeppesen Information**

In the ATC portion of the Jeppesen manual, there is a description on Korean airports as follows: “Instrument approach procedures are based on the guidance contained in PANS-OPS, Doc.8168, Vol.II and/or the United States Standards for Terminal Instrument Approach Procedures (TERPS) for civil procedures. Military and joint civil/military instrument approach procedures are based primarily on the United States TERPS.”

In the Jeppesen manual, there are two kinds of approach chart formats; one is for the procedures designed with ICAO criteria, the other with FAA TERPS criteria. At the time of accident, all the ROK approach procedures in Jeppesen chart whether they are designed with ICAO or FAA TERPS criteria, were identified as TERPS criteria. See Figure 1-11A of KAIB report.

Air China provides each international flight with Jeppesen chart. CA129 flight had carried the Jeppesen approach chart. CA129 flight crew was clear about the mountainous terrain to north of the airport. In the approach briefing, the captain said: “We won’t enlarge the traffic pattern ...the mountain is all over that side.”, and the first officer also cautioned: “Turn quickly, not too late”, but the crew were not made clear of the size of circling protection area.

The position of key obstacle (719 feet), in the topographic chart of Jeppesen as shown on Figure 1-12 of KAIB report, which relating with the site where CA129 crashed, was about 2km deviated from the actual position by east, which had an adverse influence on pilot’ recognition of the terrain.

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<sup>4</sup> The ROK AIP authority revised its AIP information in August 2002. In the part of ENR1.5, the TERPS criteria applied to the Gimhae Airport was described, and principles to determine the aircraft category using the TERPS criteria are included. In the approach chart of Gimhae Airport, circling speed, area and appropriate obstacle information are marked.

## **2.6 Aircraft Category**

### **2.6.1 Category of B767-200**

In accordance with the ICAO standard, the definition of aircraft category is based on 1.3 times stall speed in the landing configuration at maximum certificated landing Mass..

Category “C”- Indicated air speed is 224 km/hour (121 knots) or more but less than 261 km/hour (141 knots)

Category “D”- Indicated air speed is 261 km/hour (141 knots) or more but less than 307 km/hour (166 knots)

According to this definition, the related speed of B767-200 is 137 knots, with which B767-200 was classified as Category “C” aircraft.

### **2.6.2 Discussion of CA129 category by Air Traffic Controller of Gimhae Airport**

Before the approach controller notified the crew of the runway change to use circling approach, as the weather condition then was above the circling approach minima for Cat “C”, but below that for Category “D”, the approach controller queried the CA129 for aircraft category . After the flight crew replied “C”, the clearance of runway change was issued to CA129. After the tower controller had confirmed from the approach controller that CA129 was B767-200 , he was suspicious of whether CA129 was Category “C”. Then he asked the flight information office by phone. The flight information office thought CA129 to be B737. After the tower controller had confirmed B767, the flight information office said: “In case of B767-200, then it is related to category “D”. After the tower controller confirmed the aircraft type again with the approach controller, he discussed again with the flight information office on the category of B767-200, the flight information office said: “We can consider it is category “C” if the pilot said so”

In the circling approach, maximum indicated air speed of CA129 on the downwind leg was 158 knots. Based on ICAO standard, it was still within the speed limits for the Category “C”. But the flight procedures of Gimhae airport is designed with TERPS, circling minimum of Category “D” should be used when the speed exceeds 140 knots.

Neither the flight crew nor controllers were aware that actual category minimum was related to the speed with speed, i.e. although B767-200 was Category “C” aircraft, circling minimum of Category “D” should have been used during circling approach because the speed exceeded 140 knots. If CA129 descended to 1100 feet as required for Category “D” minimum, it would not have crashed into mountains of 669 feet.

### **2.6.3 Management of the Civil Aviation Authority of ROK on Aircraft Category**

At the time of accident, there were no prescription on aircraft category in the applicable aviation regulations of ROK, and no statements was made on how to use the approach

minimum in the ROK AIP.

Busan Regional Aviation Authority of ROK required all the airlines operating at Gimhae Airport to report the aircraft types and their approach category (including circling) in written form, and then notified this information to Gimhae military ATC unit. But prior to the accident, Air China was not required to provide such kind of form.

On the same day before the accident, two A321 aircraft, when making circling approach, were directed to descend to MDA 700feet of Category “C” minimum. The speeds on downwind leg of both aircraft exceeded 140knots. This shows that in such case as that two design criteria of flight procedures are used at the same time in Korea, it is not exceptional to make mistakes in the category judgment.

IACO 《Manual of All Weather Operations》 (Doc 9365-AN/910) stipulates: “The state of the Aerodrome has responsibility for safety of air navigation within its own borders. It follows that it retains the authority to accept the minima approved by other States at its aerodromes. ” Due to particularity and frequent utilization of the circling approach procedure of Gimhae Airport, if the Busan Regional Aviation Authority had informed all the airlines operating in Gimhae airport of this special requirements on category, it would have drawn the attention of relevant flight crew and controllers.

## **2.7 Airport Runway Lighting**

Since the clock within the computer system at Gimhae airport lighting control room was reset 19 minutes back at 20:30, April 18<sup>th</sup> after the accident, the Chinese investigation team holds that doing so violated the relevant regulations provided in ICAO Annex 13. According to the statement of the Captain in the interviews and public hearing, the Chinese investigation team is suspicious of the circling guidance light being turned on at the time of accident.

### **3. CONCLUSION**

#### **3.1 Findings of the Investigation**

1. The flight crewmembers and flight attendants had received training. They were certified and qualified for this flight.
2. The aircraft was certified airworthy; weight and balance were within the specified limits.
3. In the final preflight maintenance inspection prior departure at Beijing Capital International Airport, any defects were not found in the fuselage of the aircraft as well as its systems and engines. During flight, the crew didn't report any malfunctions, and the examination of the aircraft wreckage did not show any possible malfunctions.
4. The south wind was strong at Gimhae airport when the accident occurred. There was low clouds and precipitation. The mountainous area in the north was shaded by cloud and fog. The circling approach was difficult under such weather condition.
5. The air traffic of Gimhae Airport was controlled by Air Force. It was appropriate in accordance with the related regulations and procedures of Korea for the Air Force controller to provide services to civil aircraft.
6. When the tower controllers lost the visual contact of CA129, they failed to use radar to determine the location of aircraft, and when low altitude warning displayed, they did not issue a safety alert.
7. When the approach controller found that the downwind leg of CA129 was longer than the normal and MSAW warning, he reminded the tower controllers, but no response received. The approach controller failed to take further measures to alert the flight crew.
8. The functions of Minimum Safe Altitude warning system (MSAW) at Gimhae airport did not conform to the relevant prescription of ICAO, for it was not equipped with aural alert.
9. Transfer instruction issued by the approach controller was hard to recognize, resulting in the short interruption in ATC process.
10. On the control radar display, the boundaries of the protected area of circling approach for all categories of aircraft were not depicted, and the marks of obstacles in the mountainous north of the airport were not complete.
11. In the Jeppesen approach chart used by CA129 flight crew, the position relationship between the runway and the key obstacles relating the site of the accident was wrongly marked.

12. The flight crew's training in circling approach was conducted in the simulator, but they had never conducted the training of circling approach to Gimhae Airport's runway 18R.
13. Air China provided an insufficient Crew Resource Management (CRM) training for the three-pilot crew.
14. The flight crew participated in classes of various legal regulations according to Air China's operational requirements, but during this flight they performed its circling approaching in violation of the circling minimum of wide-body aircraft.
15. When the crew performed circling approach to enter the downwind leg, the width was narrower than normal, and no corrections were made.
16. It cannot be confirmed that the circling guidance lights was turned on when the aircraft was approaching.
17. The contents of Automatic Terminal Information Service manually recorded at Gimhae airport was hard to comprehend, and the controller did not use VHF to inform the crew of the important information that the weather conditions were below the minima of circling approach for Category "D".
18. The ground proximity warning system (GPWS) installed at the aircraft, due to the fact that the terrain warning was inhibited when aircraft had been in landing configuration, , did not generate any warning just before the ground impact.
19. As of April 15th, 2002, there was no recording of any difference from ICAO Standard on aircraft category in ROK AIP.
20. The visual field of meteorological observation site of Gimhae Airport did not meet the appropriate requirements of 《Guide to practices for meteorological offices serving aviation》 of World Meteorological Organization.
21. When the aircraft disappeared from radar and radio contact of the aircraft with tower was lost, the tower didn't notify search and rescue department in time, while local residents called 119 about the case.
22. The Korean Civil Aviation Authority did not inform the CAAC and Air China of listing the Gimhae airport as a "special airport".

### **3.2 Probable Causes**

Chinese investigation team believes that possible causes of the accident might be:

At the time of accident, weather condition was poor with low cloud , precipitation and low visibility. There was strong tailwind on the downwind leg and the mountainous area north of the airport was covered by cloud. The flight crew mishandled in performing the circling approach to runway 18R. The flight crew did not make the base leg turn at the proper time, thus led the aircraft to fly outside the circling approach protection area. The flight crew didn't execute miss approach when they lost the sight of the runway during the visual maneuvering of the circling approach.

When MSAW warning appeared on the radar display, the controller failed to provide safety warning to the flight crew; unintelligible frequency transfer instruction and frequent communication with the flight crew had an impact on the flight crew's operation of base turn and final approach.



#### **4. SAFETY RECOMMENDATIONS**

After more than two years' investigation, Chinese investigation team suggests safety recommendations to Air China , General Administration of Civil Aviation of China, Korea Ministry of Construction & Construction, Korea Ministry of National Defense and Korea Airport Corporation:

##### **Air China**

1. Make more explicit circling minimum of aircrafts in operation specifications and flight operation manual, further improve the circling approach procedure in the flight training program.
2. Contents of various briefings and the implement of procedures used by the flight crew in flight should be often reviewed. The flight crew resource management training should be strengthened.
3. The analysis and evaluation on the risk factors of airports used by Air China should be taken to enhance the consciousness of keeping away risks. Busan Gimhae Airport should be listed as one of the special airports to strengthen a pertinent training on this airport.
- 4 The Enhanced ground proximity warning system (EGPWS) should be added in accordance with CAAC's airworthiness order.
5. In flight to Korea, cabin broadcast in Korean language should be added.

##### **General Administration of Civil Aviation of China**

1. A sustained inspection on the training of flight crew should be strengthened.
2. For international flights, the airlines should be required to include the local language in passenger announcement.

##### **The Korea Ministry of Construction and Transportation**

1. The operating procedure for tower radar should be improved, and specific prescription on the functions and usage of the radar warning be made.
2. Airports used by civil aviation should apply unified flight procedure design criteria. In case that the applied criteria are different from the ICAO standards, they should be stated in the AIP in order to avoid confusion when used by pilots and the ATC controller.

3. Military controllers engaged in controlling civil aircraft should participate in civil aviation ATC training and obtain the controlling certificate issued by civil aviation authorities.
4. Consider to adopt new technology and satellite based navigation system to improve the operation safety of airports with challenged terrain.
5. The colored contour and relief should be depicted in the approach chart in accordance with requirements of ICAO Annex 14.

### **Korea Airport Corporation**

1. It should be made clear that who is responsible for service of the airport's lighting system, and establish the implementation procedure, so as to ensure the integrity of records for the exact time of on/off of the airport's lights.

### **The Ministry of National Defense (Air Force)**

1. Considering that the north terrain of Gimhae airport is complicated, the instrument approach procedures to runway 18R should be established, the airfield control radar be upgraded and corresponding alert be set up according to the requirements of ICAO Annex 11 and Document 4444.
2. The communication facilities in ATC unit of Gimhae Airport should be improved and maintained to improve the quality of ground-air communication. ATC controllers' English level should be improved.
3. A voice synthetic system should be used for ATIS to improve the reception quality.
4. A better observation site with unobstructed view should be chosen at Gimhae Airport in order to provide timely and correct weather report.

## REFERENCE DOCUMENTS

- A. CVR record
- B. ATC record (including the intercom record)
- C. Records of the Public Hearing
- D. KAIB Accident Report ( draft )
- E. Flight Safety Foundation 《 Approach and Landing Accident Reduction (ALAR) 》
- F . ICAO 《CFIT education and training aid》
- G . Applicated Regulations

### ICAO

- Annex 2 《Rule of the air》
- Annex 3 《Meteorological Service for International Air Navigation》
- Annex 4 《Aeronautical Charts》
- Annex11 《Air Traffic Services》
- Annex 13 《Aircraft Accident and Incident Investigation》
- Annex 15 《Aeronautical Information Services》
- Doc 4444 《Procedure for air navigation services - Air Traffic Management》
- Doc 8168-OPS/611 《 Procedure for air navigation services - Aircraft Operations》 ( I , II )
- Doc 9365 AN/910 《Manual of All weather operations 》
- Doc 9426-AN/924 《Air Traffic Services Planning Manual》

### MOCT

- 《Standard Operation Procedure of Air Traffic Control》
- Gimhae Airport 《Local Operation Procedure》

### CAAC

- 98<sup>th</sup>order 《 Rules for Aerodrome operation minimum establishment and implementation》

**FAA**

Order 7110.65 《Air traffic Control》

Order FAA 7210.3 《Facility Operation and Administration》

Order 8260.3 《Terminal Instrument Procedures》 ( TERPS )