Aviation Safety Council

Taipei, Taiwan

GE791 Accident Investigation
Factual Data Collection
Group Report

Flight Operations Group

October 28, 2003

ASC-FRP-03-10-001

Intentionally Blank

I. Team Organization

Chairman:

Hsueh-Jen Ranger Chen

Investigator, ASC, ROC

Members:

1. Pei-Da Lin
   Engineer, ASC, ROC
2. Cheng-Chun Billy Sun
   Inspector, CAA, ROC
3. Wei-Chien Sun
   ATR72 Captain, TNA, ROC
4. Edoardo d'Aniello
   Flight Safety Officer, ATR Aircraft Manufacture Corporation

II. History of Activities

Date	Description
Dec-21-2002	1. Issuing an official letter to Civil Aeronautics Administration (CAA) and Trans Asia Airways (TNA) to provide relevant information necessary for the investigations on flight operations. 2. Interviewing with: ● Persons who drew up GE791 loading plan; ● Persons who filled out GE791 Weight & Balance sheet; ● One crewmember of a scheduled flight that was passing through the nearby airspace when the accident occurred. 3. Visiting TNA office at C.K.S. International Airport to collect GE 791 weight and balance information; visiting CKS Flight Information Station and Flight Operations Section to gather the photocopies of the information used by GE791 and the Approach to get the ATC recording; and visiting TNA' Freight Transport Section at C.K.S. International Airport to gather the documents of GE791 cargo data, the loading procedures and regulations.
Dec-22-2002	Interviewing with: ● One crewmember of another scheduled flight that was passing through the nearby airspace when the accident occurred.
Dec-23-2002	1. Discussing on investigation process regarding Flight Ops. 2. Preparing for follow-on investigations and interviews.
Dec-25-2002	1. Held a meeting to coordinate and draw up an interview plan. 2. Discussing with chief prosecutor of Penghu District Prosecutor's Office on anatomy and examination of pilot bodies. 3. Obtaining letter of agreement from dependants for the anatomy and examination of pilot bodies.
Dec-26-2002	1. Interviewing with: ● Flight crew whom flied with captain of GE791 (referred to "CM-1" hereinafter) before the accident. ● Flight crew whom flied with the first officer of GE 791 (referred to "CM-2" hereinafter) on the passenger flight mission before the accident. ● Flight crews whom flied with CM-1 on the last second passenger flight and previous freighter.

	2. Reaching an agreement with forensic investigator of Ministry of Justice over an anatomy.
Dec-27-2002	Interviewing with: ● Flight crew who flied B22708 on the last second flight mission before its accident. ● Flight crew whom flied with CM-1 on the last second freighter before its accident. ● A certain leader of TNA flight operations.
Dec-30-2002	1. Interviewing with: ● Flight crew whom flied with CM-2 on the last second freighter before the accident. ● A certain leader of TNA flight operation. ● A certain dispatcher of TNA. 2. Discussing with ATR representatives about the definitions, process, indications of icing and severe icing, and procedures.
Dec-31-2002	Interviewing with: ● Flight crew whom flied B22708 on the last flight before its accident. ● Flight crew whom flied B22708 on the last second flight before its accident. ● Flight crew who performed flight GE793 on November 28.
Jan-2-2003	1. Interviewing with: ● CAA designated examiner who conducted the latest simulator rating for CM-1 and the latest simulator rating as well for CM-2. ● The check pilot who conducted the latest route check for CM-2. 2. Exchanging opinions with aviation safety inspector of Flight Standard Division, CAA.
Jan-6-2003	Interviewing with: ● Flight crew whom flied with CM-2 in the mid night of December 15. ● Flight crew who performed the flight mission between CKS and Macau airports before the accident.
Jan-7-2003	1. Interviewing with: ● Workers, 15 in total (of a Ground Service Company), who carried out loading operation for GE791. ● Staff member for the second time who prepared the loading plan for GE791. 2. Collecting documents regarding the loading/unloading operation

	procedures, regulations and training records from the aforesaid Ground Service Company.
Jan-8-2003	Interviewing with: ● A leader of TNA flight safety office. ● Two leaders of TNA flight operations units.
Jan-9-2003	1. Interviewing with a certain leader of TNA flight operations department. 2. Collecting related records and documents from TNA System Operation Center. 3. Collecting all training records of CM-1 and CM-2.
Jan-14-2003	1. Examining the licenses, certificates and related documents of CM-1 and CM-2. 2. Examining the airworthiness data of B22708 and the simulator used by ATR fleet. 3. Examining the training programs and records of CM-1 and CM-2 in recent two years and all their tests and qualifying records in ATR fleet. 4. Examining the Flight Crew Operations Manual, Flight Training Management Manual, and the operations manuals of Security & Safety Office, Flight Operations Department and System Operation Center of TNA.
Jan-15-2003	1. Listening to the CVR recording. 2. Held a meeting on investigation progress. 3. Examining the ATR72 Anti-icing System and its operation procedures.
Jan-16-2003	1. Reviewing the AFM, FCOM, QRH and MMEL of ATR72 for chapters related to the phenomenon of icing, de-icing / anti-icing and corrective measures for abnormal procedures, operation techniques, normal procedures and emergency procedures. 2. Reviewing the relevant rules, preparation and performance regarding the load and trim operations of GE 791. 3. Collecting and discussing the operations regarding the anti-icing and de-icing systems of FK50 and DASH 8 aircraft. 4. Examining the relevant data about disposition in the cargo bays of B22708. 5. Reviewing the techniques, procedures, warnings, cautions and notes in AIM and FAR with regard to the icing, anti-icing and de-icing operations.

Jan-17-2003	1. Drawing up a draft of Interim Flight Safety Bulletin. 2. Planning steps to investigate “the icing/de-icing trainings and rating of TNA ATR72 fleet pilots.”
Jan-20-2003	1. Discussing the training and checkride status of TNA ATR72 fleet pilots and instructor pilots. 2. Interviewing with a certain leader of TNA flight operation department.
Jan-21-2003	1. Verifying the CVR transcript in coordination with the Recorder Group. 2. Interviewing with a certain TNA engineer.
Jan-22-2003	1. Discussing the contents of FOM and Operations Manual of TNA flight operations department. 2. Studying FDR parameters, it’s manual, and listing the required items for FDR parameter data.
Jan-24-2003	1. Interviewing with a certain aviation safety inspector of CAA. 2. Held a meeting on investigation progress.
Jan-27-2003	1. Visiting TNA to discuss FDR recorded parameters and methods, and bring back pertinent data with regard to FDR recorded parameters.

III. Factual Description

1.1 History of Flight

On December 21, 2002, at 0152[1] Taipei local time, Trans Asia Airways (TNA) freighter GE791, aircraft type ATR72-200, registration No.B22708, encountered a severe icing during its flight and crashed into the sea 17 kilometers southwest of Makung city, Penghu Islands. Both pilots (CM-1 and CM-2) on board were missing.

Around 2310, December 20, 2002, the flight crew arrived at TNA office at Chiang Kai-Shek (CKS) International Airport and was prepared to flight from CKS International Airport to Macau International Airport.

About 0056, December 21, 2002, GE791 started engine from cargo apron 508. It was airborne on Runway 06 at 0104 and via CANDY 1 departure (see Attachment 2-1). It reached the assigned flight level 180 (FL 180) at 0125 and joined A-1 when passing MKG VOR/DME.

According to the Meteorological Conditions data[2]: The ground temperature was 20 degrees Celsius when GE791 departed from CKS International Airport and the estimate temperature at the altitude of 18,000 ft of accident area was minus 9 degrees Celsius.

The Flight Data Recorder (FDR) parameters showed that the airframe de-icing system was activated during the periods of 0134 to 0137 and 0141 to 0152 (when the FDR stop recording) respectively.

According to the Cockpit Voice Recorder (CVR) transcript:

0132	CM-2: it seems to be icing…look my side, it is also icing on your side, isn't it
	CM-1: oh, it is icing
0144	CM-1: it is icing, quite a big lump
0150:29[3]	CM-1: wah-oo, such a big lump.
	CM-2: what ice it is.

Note:
[1] All of the time shown herein represents local time in 24-hour system.
[2] The validity of the Meteorological Conditions data was from 8pm Dec. 20 to 8am Dec. 21.
[3] 0150:29 means 1 o'clock 50 minutes 29 seconds, and this apply to the time referred hereinafter.

0150:55 CM-1: the speed is slowing down. originally, it was one hundred, two hundred. oh, one ninety and now it is one seventy.

After discussed with CM-1 for a short while; at 0151:38, CM-2 said: you want high or ah, it is severe icing. After a discussion again, CM-2 at 0151:51 requested and approved from Air Traffic Control to descend to FL 160. FDR data showed: GE791 began to descent at 0151:56

0152:02 CM-1: do you see that

0152:08 CM-1: it is severe icing

0152:10 CM-2: sir.

The CVR has recorded various warning sounds during the 40 seconds from 0152:11 to 0152:51 (when the CVR stopped recording).

0152:25 CM-2: pull up, sir. (This was the last dialogue between them.)

Furthermore, the FDR has shown:

- When the aircraft reached and maintained FL180, the lowest indicated air speed recorded was 157kts/ at 0151:12 and the highest was 436kts at 0152:50 when the FDR stopped recording.
- At 0152:12, the aircraft began pitching down. Starting from 0152:23.5 till the stop of FDR, the pitch angle exceeded 50 degrees all the time with 85.9 degrees the biggest one. At 0152:09, a left bank developed and reached up to 48.9 degrees two seconds later. From then on, the bank degrees were constantly changing until the FDR stopped with the biggest one exceeding 90 degrees.
- The maximum vertical acceleration speed was 4.02G at 0152:45.375.
- A disengage of the autopilot was recorded at 0152:11.

1.2 Injuries to Persons

Injuries	Flight Crew	Passengers	Others	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0
Missing	2	0	0	2
Total	2	0	0	2

1.5 Personnel Information

1.5.1 Backgrounds and Experiences of Flight Crew Members

1.5.1.1 CM-1

The nationality of CM-1 is Republic of China who had served in military, as a freighter pilot and his total flight time was 3,638:45 during his military service. He joined in TNA in February 1991 as a first officer of ATR42. In May of the same year, he completed ATR42/72 differential training and was promoted as a captain of ATR42/72 in September 1993. His total flight time was 14,247:33 which included 10,608:48 on ATR42/72 as of the accident.

1.5.1.2 CM-2

The nationality of CM-2 is Republic of China who completed his ATR42/72 initial type training in Flight Safety International U.S. from June 1996 to July 1997 with 307 total flight hours at that time. He joined in TNA in September 1997 and completed ATR42/72 differential training on November 27. In July next year, he completed required training courses and quality as a first officer of ATR42/72. His total flight time was 4,578:48 as of the accident.

Table 1.5.1-1 Basic Information of Pilots

Item	CM-1	CM-2
Gander	Male	Male
Age as of accident	53	34
Date of joining in TNA	February 20, 1991	September 15, 1997
License type	Airline Transport Pilot No.101096	Airline Transport Pilot No. 102065
Type rating Expire date	ATR42/72 August 31, 2003	ATR42/72 F/O January 6, 2004
Medical class Expire date	1st class airman March 31, 2003	1st class airman April 30, 2003
Latest flight check	July 25, 2002	June 23, 2002
Total flight time	14,247 hrs 33min.	4,578 hrs 48 min.
Flight time in last 12 months	887 hrs 37 min.	873 hrs 14 min.
Flight time in last 90 days	201 hrs 14 min.	178hrs 44 min.
Flight time in last 30 days	59 hrs 46 min.	42 hrs 11 min.

Flight time in last 7 days	8 hrs 52 min.	11 hrs 05 min.
ATR42/72 flight time	10,608 hrs 48 min.	4,271 hrs 48 min.
Flight time on the day of accident	0	0
Rest time period before accident	Over 24 hrs	Over 24 hrs

1.5.2 Training and Rating Records of Flight Crew

1.5.2.1 CM-1

Initial training: Completing ground academic courses training of ATR42 flight crew at ATR Training Center, France on March 29, 1991; passing the rating of first officer on performance and takeoff/landing skills on April 22; completing differential training of ATR42/72 aircraft on May 16; and passing the first officer flight route check on May 21.

Up-grade training: Finishing ground academic courses training of ATR42/72 pilot; passing the rating of captain on performance and takeoff/landing skills on August 13, 1993; and passing the captain flight route check on August 27.

Recurrent training: Simulator recurrent training of TNA pilots had been conducted at FlightSafety International, U.S.A., between 1991 and 1997, and has changed to at Asian ATR Training Center, Bangkok, Thailand, since October 1997. The pilots are trained by TNA instructor pilots and examined by TNA designated examiners designated by CAA.

The recurrent training and rating records indicated:

1. In addition to the listed items of the ATR Recurrent Training Rating Record sheet filled out on October 18, 1998, the item “ICING CONDITION EXERCISES” was added on the Item column but its score column was remained blank.

2. On the Recurrent Training Record sheet of July 21 to 22, 1999, handwritten “+ ICING” were added to the “Approaches to Stalls” item column and an “S” (satisfactory) was shown in its score column. For this recurrent training, “WEAK SYSTEMS KNOWLEDGE BUT IS ABLE AND VERY WILLING TO LEARN” was put in the Remarks column of ATR Recurrent Training Rating Record sheet.

3. On the Recurrent Training Record sheet of March 17 to 18, 2000, handwritten “INCLUDE ICING” was added to the “Approaches to Stalls” item column and an “S”

was shown in its score column. For this recurrent training, “TENDENCY TO LOSE SITUATION AWARENESS – AUTOPILOT NOT ENGAGED BUT NOT AWARE AND LEAD TO STICK SHAKER STALL, SEVERE BANK>45°WITH SINGLE ENG. RE-DID EXERCISE SEVERAL TIMES WAS OK. – BUT STILL UNSTEADY.” was put in the Remarks column of ATR Recurrent Training Rating Record sheet.

4. The score column of ATR Recurrent Training Rating Record sheet of July 9, 2001, showed “PASS.”

5. The score column of ATR Recurrent Training Rating Record sheet of February 20, 2002, showed “PASS.”

1.5.2.2 CM-2

Initial training: Finishing ground academic courses training of ATR42/72 pilot at FlightSafety International, U.S.A. in August 1997; starting ATR72 aircraft initial type training after joining in TNA in September 1997; completing differential training of ATR42/72 aircraft on November 27; passing the rating of first officer on performance and takeoff/landing skills on February 18, 1998; and passing the first officer route check on April 5.

Recurrent training: From completion of initial training till the occurrence of accident, CM-2 had successfully past all recurrent trainings and ratings without any unusual remarks in records.

1.5.3 TNA Flight Crew Members’ Ground School Recurrent Training

A ground school of recurrent training for TNA flight crew is conducted prior to the twice-per-year’s recurrent trainings. The curriculum of the one-day ground school training program includes:

1. Civil aviation regulations, one hour;

2. Crew resources management (CRM), one hour;

3. Controlled flight into terrain/approach and landing accident reduction/ground proximity warning system (CIFT/ALAR/GPWS), one hour;

4. Abnormal operations of aircraft systems, two hours;

5. Instructor pilot’s briefing, one hour;

6. Traffic alert and collision avoidance system (TCAS) operation or cold weather operation including operations when passing through a thunderstorm and usage of

weather radar--Traffic alert and collision avoidance system (TCAS) operation is conducted in between April and September; cold weather operation in between October and March; one hour.

7. Other curricula (such as Fleet Circular) that need to be replenished or reinforced; and

8. Tests; one hour.

According to interview records, the recurrent training curricula and tests under flight crew the instructor pilots of the type of aircraft fleet conduct member's regular ground school recurrent training program.

1.5.3.1 CM-1

CM-1's ground academic courses training records in recent two years provided by TNA showed the dates and tests scores as follows: 98 points on January 9, 2001; 100 points on July 2, 2001; 100 points on January 31, 2002; and 100 points on July 19, 2002.

1.5.3.2 CM-2

CM-2's ground academic courses training records in recent two years provided by TNA showed the dates and tests scores as follows: 100 points on January 9, 2001; 98 points on May 17, 2001; 94 points on December 18, 2001; and 95 points on June 11, 2002.

1.5.4 Other Related Trainings of Flight Crew Members

A one-day "Specify Training" is conducted once every year for TNA flight crew members that include crew resources management training, anti-hijacking, hazardous material, cardiopulmonary resuscitation (CPR) and emergency escape. The training records in recent two years showed as follows: CM-1's training date was May 15, 2001, and May 16, 2002; CM-2's training date was July 16, 2001, and October 17, 2002.

1.5.5 Flight crew members' physical conditions

1.5.5.1 CM-1

The item of limitations on the Airman Medical Certificate issued by CCA to CM-1 noted: "Holder shall wear correcting glasses"

15.5.2 CM-2

The item of limitations on the Airman Medical Certificate issued by CCA to CM-2 noted:

“none”.

1.5.6 Flight Crew Members’ Activities in 72 hours prior to the Accident

1.5.6.1 CM-1

1. December 18: Stayed overnight at Kaohsiung after finishing previous day’s flight and reported to Kaohsiung Section company at 0720 to perform Kaohsiung→ Makung → Kaohsiung→ Makung→ Sungshan flights. He was off-duty after landing Sungshan Airport around 1200.
2. December 19: On furlough and took his family for an outing.
3. December 20: Spent leisure daytime at home and reported to TNA office at CKS International Airport around 2310, then implemented this flight.

1.5.6.2 CM-2

1. December 18: Stayed overnight at Hualien after finishing previous day’s flight and reported to Hualien Section company at 0650 to perform Hualien→ Sungshan flight. He was off-duty after landing Sungshan Airport at 0812.
2. December 19: On furlough and stayed at home.
3. December 20: Spent leisure daytime at home and reported to TNA System Operation Center at 2140. After receiving a flight crew briefing, he took a vehicle to CKS International Airport and then implemented this flight.

1.6 Aircraft information

1.6.13 Weight and Balance

The total takeoff weight of this aircraft was 21,217 kg as the cargo 6,455kg in weight. The center gravity of takeoff was 27.9% and the location of center gravity was within the limited range between 23% and 29%. The Stabilization Setting was 1.0. See Table 1.6-5 for loading and trimming data. Figure 1.6-8 shows the schematic of ATR72 cargo compartments locations. For the loading and trimming table, see Attachment 2-2.

Table 1.6-5 Weight and Balance Data

Zero fuel weight	11,803 kg
Limit of payload	6,738 kg
Total payload of cargo	6,455 kg
Details of cargo weight for each of compartments Bay #11 566 kg Bay #12 1,069 kg Bay #13 1,035 kg Bay #21 1,103 kg Bay #22 1,136 kg Bay #23 1,164 kg Bulk Cargo 382 kg	
Takeoff fuel weight	3,000 kg
Consumed fuel when taxing	41 kg
Total takeoff weight	21,217 kg
Location of takeoff center gravity	27.9% M.A.C.
Stabilization setting	1.0

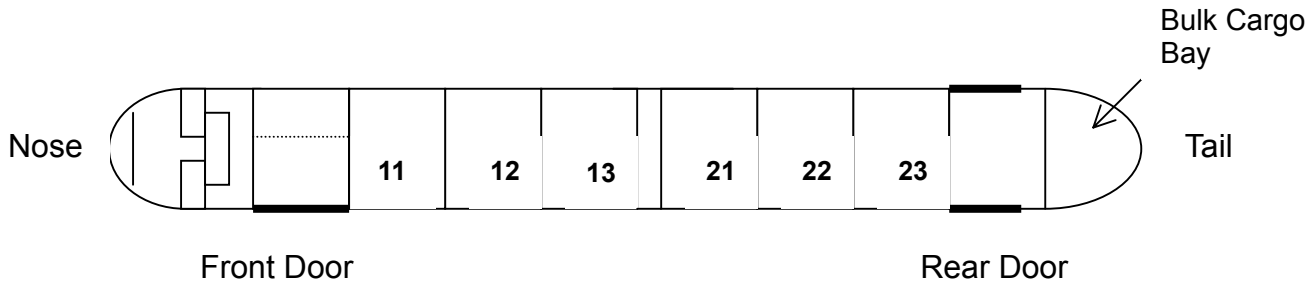


Figure 1.6-8 Schematics of ATR72 Cargo Bays

1.15 Survival Aspects

No relevant factual information is available.

1.17 Organizational and Management Information

The depictions stated in this Section are based on the status as of the time when the accident took place.

1.17.1 Organization and management pertaining to TNA

TNA is composed of Security & Safety Office, System Operation Center, and Flight Operations Department among other units. See Figure 1.17-1 for details.

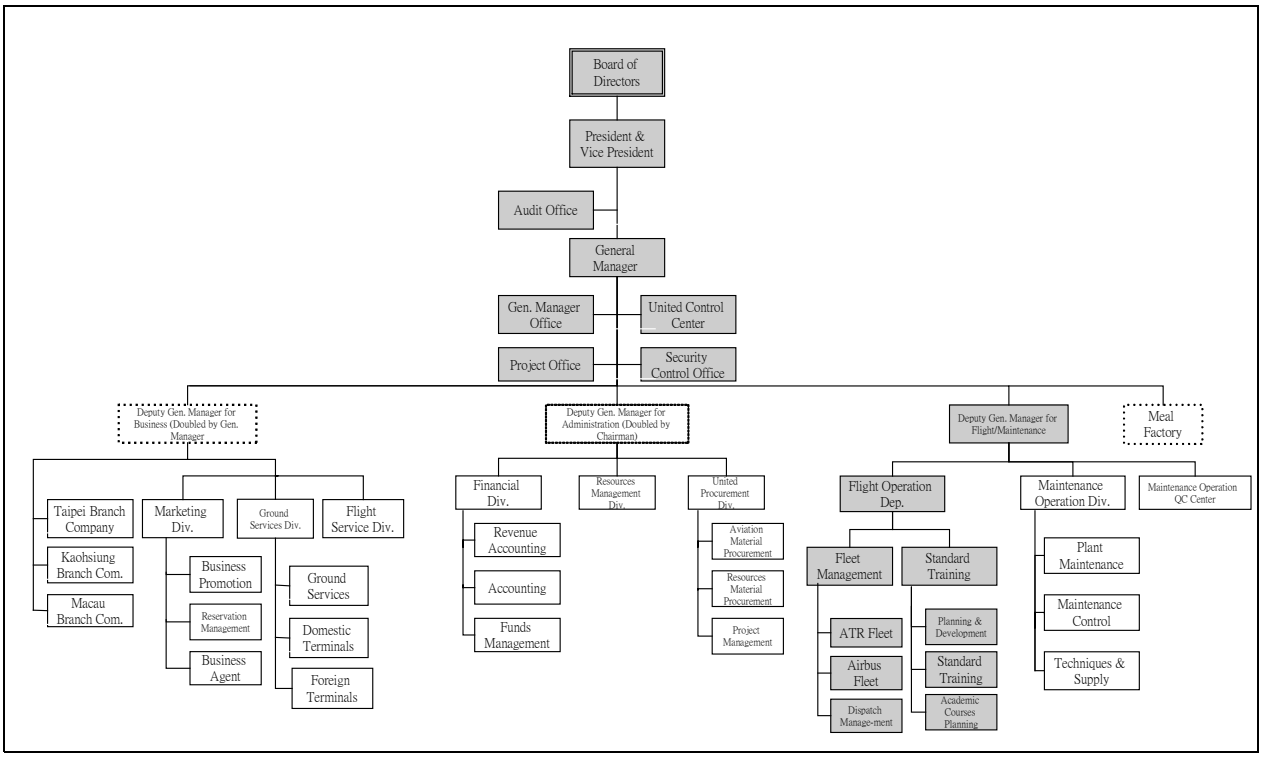


Figure 1.17-1TNA Organizational Chart

1.17.1.1 System Operation Center

The System Operation Center (SOC) is subordinated to General Manager Office. According to "Operations Manual of TNA System Operation Center":

1. The purposes of establishing SOC are *"to strengthen the functions of TNA airport business coordination and aircraft fleet dispatching operation under the premise of assuring flight safety in order to implement an effective management of air traffic, and serve as a means of rapid response measure to meet the demands of*

ever-increasing air transportation."

2. The functions of SOC include: *"…6. Giving a briefing on Flight crew mission." The functions of SOC dispatchers include "assuring that crew members are to report for duty in time" and "presenting relevant operational information regarding the flight which include…and signing the Flight Plan and the Takeoff Clearance together with captain after the captain confirms that the Flight Plan contains no doubts about flight safety…."*

3. The operational procedures of SOC include that *"members of domestic flight crew shall check in to SOC 40 minutes prior to their first departure time and members of international flight crew who fly from CKS International Airport shall check in to SOC 20 minutes prior to transport to CKS International Airport."*

The SOC is staffed with a Vice Manager, a deputy director and 12 dispatchers. All staff under deputy director (inclusive) has licenses for dispatching, and dispatchers in shifts perform the dispatching tasks. Since the introduction of nighttime flights, deputy director has joined in the shifts sometimes.

1.17.1.2 Security & Safety Office

The Flight Safety Office under TNA Flight Operations Department was separated and transferred to under General Manager Office in May 1995. The functions of security protection and labors safety were incorporated into the Safety Control Office to become Security & Safety Office (SCO) on January 1, 2002, which are manned with 6 persons: 1 director, 3 assistants and 2 senior officers.

The interview records indicated:

The functions of Safety Control Office involve units of flight operation, engineering and maintenance operation, QC, ground services. Its main tasks include:

1. Assisting flight operation department in analyzing Line Operations Monitor System (LOMS) and dealing with general business regarding flight safety;

2. The LOMS operation is divided into two parts: the SCO is responsible for operation management and analysis of overall trend, and the Flight Operations Department designating pilots to provide assistance in confirming incidents and handling the follow-on work;

3. Participating daily maintenance meeting to have an awareness of operating conditions;

4. Coordinating Ground Services Division and heads of each station to conduct selective inspections of flight safety procedures and report the results to SCO via fax machine;
5. Implementing hazardous material education to all employees of TNA;
6. Organizing a mobile education team to instill the concept of “all-employees flight safety” in which each unit is responsible for flight safety of its own; and
7. Flight Operations Department is responsible for handling “flight crew reports” while units involving flight safety are providing assistances together with SCO.

1.17.1.2.1 Flight Safety Education & Training

TNA flight safety education & training include flight safety education for new employees and annual flight safety recurrent training. The flight safety education for new flight crew members includes:

1. Professional flight safety education, 2 to 4 hours;
2. Resources management training for air services crew members, 4 to 8 hours;
3. First aid and other trainings (including emergency escape, hijacking, anti-hijacking, explosive objects, hazardous material and CPR); 16 hours.

The annual flight safety recurrent training for flight crew is conducted once per year (adopting an alternative approach of classroom review and discussion and simulation practices for every other year). Training courses takes 2 to 6 hours including land escape, water escape, use of various first aid and survival equipment, flight crew’s duty and work in emergent situations and evacuation, measures for taking care of disabled and handicapped, and the physiological effects under circumstance of oxygen less over altitude 10,000 ft and in condition of failed pressure cabin.

1.17.1.2.2 All-employees Flight Safety Reporting System

All-employees flight safety report can be divided into four categories: flight crew report, passenger cabin crew report, flight safety abnormal incident report, and compulsory reporting incidents.

The flight crew report (limited to flight crew use only) must be filed when accident, serious incident, incident occurred and shortcoming are found in maintenance operations, ground handling operations, dispatching operations, passenger services, and equipment/facilities that may impose danger to flight safety and violate aviation

regulations. Flight Operations Department is the responsible unit for handling these reports.

The flight safety abnormal incident report is used (by all employees) when individual operation has imposed danger to flight safety or other individuals and/or objects that are found to have impact on flight safety. SCO is the responsible unit for handling these reports.

1.17.1.3 Flight Operations Department (FOD)

The FOD is subordinated to Deputy General Manager for Flight/Maintenance. According to Operations Manual of TNA FOD, its functions include:

1. Pushing for Flight Operation policy;
2. Assuring flight safety;
3. Developing and implementing relevant operating manuals and procedures;
4. Implementing manpower planning, training, employment, evaluation and management of flight pilots; and
5. Assigning and implementing flight missions.

The establishment of FOD includes two departments: Aircraft Fleet Management (AFM) and Standard Training (ST). The AFM is composed of AirBus fleet, ATR fleet and Scheduling Management Office, with the chief pilot of AirBus fleet doubled as manager. Under the ST department, there are three sections: Academic Courses Planning, Standard Training, and Planning & Development, with the director of Standard Training doubled as acting manager.

The (deputy) assistant vice president of FOD acts as the leader of FOD whose responsibilities include:

1. Overseeing internal affairs and communicating with other units;
2. Supervising and developing policies and procedures of TNA flight operations;
3. Supervising the implementation of flight operations;
4. Supervising training of flight crew members;
5. Supervising and planning policies to ensure flight safety; and
6. Supervising, evaluating and managing subordinates.

Followings are the summary of interviews with relevant personnel of flight operation:

Currently, the FOD have two positions remained vacant: the flight training manager for about one year and deputy director in charge of personnel records. TNA often using technical personnel to form mobile teams that result in excess workload due to manpower overlapping. FOD has no full-time on ground school instructor. In selection of manager of flight training department, the modus operandi of recommending candidates by unit chiefs had been adopted in the past. And now, the candidates are selected first by Human Resources Division, who will then be inquired by personnel unit of personal willingness, and elected by the vote of fleet pilots. The hopefuls emerged out of voting result then will be compared and assessed by general manager, deputy general manager and chiefs of flight operation units before reporting to president for a final decision.

There are two fleets in FOD, but the pilots of these two fleets receive different pay as the pilots of AirBus fleet receive higher pay than those of ATR fleet do. Pilots of ATR fleet staged a strike in 1999. Pilots of this fleet are lacking motivations to attend trainings courses and flight safety meetings due to lower pay and manpower shortage. Nevertheless, TNA has requested the pilots of ATR fleet to maintain a substantial level in hope of achieving a better management of flight operations. However, the management can only do what it can in light of a shortage of manpower and resources.

The test questions of annual training were not difficult, the instructor pilots and check pilots often gave briefing before tests. TNA has decided to drop this practice of giving briefing before tests. Generally, the evaluation records were not written in full details. The instructor pilots and check pilots have eliminated no one in the recurrent checkride that the interviewee attributes to the checkride standards adopted. TNA has considered inviting instructors from outside for the job, but it was not realized due to high costs. As to the problems of pilot competence and professionalism, they can be identified through two ways: one is from the remarks on regular tests sheet and the other from the individual performance during route check. The chief pilot will coordinate with Flight Training Office to work out a training plan for reinforcement. A monthly aircraft fleet instructor pilots meeting are chaired by the chief pilot of the two fleets alternatively.

Parts of the pilots are lacking aggressive motivations that could not be improved by training alone; a stricter evaluation system by the instructor pilots is needed. It’s not easy for all flight crewmembers to attend the meetings; therefore the Fleet Circular is used as a substitute for the meetings. What the Fleet Circular publicized are mostly the things already known and repeated, but there were still some who were mindless of

this. One of the answers to this problem lies in cultural aspect to beef up selective checking to foster the senses of seriousness and honesty of the pilots. The other way is to increase the manpower of instructor pilots and pilots.

When receiving the Notices and technical documents from outside, Flight Operations Department makes an abstract and publicizes them after chief pilot and deputy assistant vice manager put their signatures. Each pilot will get a copy. These Notices may fall within the ambits of test in the recurrent training. A member of flight operation management indicated that he didn't hear anything about the Winter Operation Reminder issued by ATR manufacturer on December 5, 2002.

TNA headquarters pointed out in the weekly Wednesday meeting one month ago that using Hong Kong as the alternate airport is not appropriate for ATR Freighter in light of the close distance to Macau when the weather changes abruptly and it would run a high risk when situation of single engine flight takes place. But, at last, the only thing could be done to respond was to persuade chief pilot to assign the pilots with better quality.

When concurrently undertaking management or administrative work, pilots have to spend much of extra time on office work besides their duty flight time, therefore most of pilots not willing to take concurrent job. But when someone did choose to pick up the job, sidelong remarks from others follow. There has been no specifically established system in written form to govern the selection of flight operation leaders. The president and general manager of TNA have been changed frequently. Each change would bring new operation style and ideas when the tacit mutual understanding runs in short supply.

TNA operation team was reshaped in March 2002. The management level has been fluctuated in the past. When it changed, the units under it changed correspondingly.

Making profits has been the policy of TNA as it has to be responsible for its shareholders. All of TNA units are endeavoring after this goal. The flight operation units are TNA's executive units and have to cooperate with company's projects. In budget, the policy of broadening sources of income and reducing expenditure to cut costs has been executed thoroughly. Employees and hardware are all managed in a most economical way. Promotion of personnel has been frozen for two years unless it is deemed a necessity. The thrift measures taken in management of personnel and administration include reducing the space of offices, merging units, consolidating the posts of leaders with that of deputy leaders, and other streamlining measures. Education and training courses are reduced substantially while those regarding flight operations are maintained only at standard level required by civil aviation regulations.

The company's participation in activities such as international annual conference and ATR annual conference has been reduced.

The number of ATR and AirBus fleets were planned to reduce to 8 aircraft for each fleet in the Project 2002 drawn up in the end of 2001. However, the surplus aircraft were unable to sell out due to shrinking aircraft market and by contraries, one more Freighter, B22708, was joined in due to some reasons. This aircraft arrived at CKS International Airport in December 2001 and was converted into a freighter after inspection and repair. It started to fly between Taipei and Macau from February 26, 2002. Since the release of Project 2002, the manpower streamlining policy has been implemented under a preferential payment program. The civil aviation regulations have imposed restrictions on maximum flight time of pilots, but as in the case of manager of Standard Training Department, doubled by director of Standard Training Division who has to fly for 40 hours per month and handle staff work in non-flight duty hours. According to the monthly flight schedule, each pilot's flight time sum up to 80 to 85 hours, but their actual monthly flight time were 65 to 70 hours due to incidental cancellation of flights. This has caused perplexity in mission assignment and diminished the willingness of pilots to attend training courses and flight safety meetings.

In the past, Flight Crew Report has been rarely filed in TNA. Now, it is a mandate that any problem be reflected in "Flight Crew Report " which will be sent to relevant unit for an answer. Then the chief pilot will hand it over to captains for confirmation. After signed by deputy general manager of Flight/Engineering and Maintenance Divisions, the case is officially closed. Pilots will be punished if they have not written a "Flight Crew Report " when it should be done.

1.17.1.3.1 Fleet Management Department

1. Aircraft Fleet

ATR fleet has 10 ATR72 passenger aircraft and 1 ATR72 freighter with 33 captains (of which 3 are CAA designated examiners, 2 are check pilots and 2 are instructor pilots) and 27 first officers, 60 in total. AirBus fleet contains 9 AirBus 320/321 aircraft with 28 captains (of which 2 are CAA designated examiners, 3 are check pilots and 3 are instructor pilots) and 26 first officers, 54 in total.

According to Operations Manual of TNA Flight Operations Department, the responsibilities of chief pilot include:

1. Implementing test and evaluation of pilots;

2. Conducting selection review of new pilots, pilots for advanced training and pilots for

transfer training, and manpower planning;

3. Attending and supervising required study classes;
4. Management of fleet personnel including pilot flight skills, disciplines and habits in daily life;
5. Conducting checks on various skills and evaluation of annual individual pilot performance; and
6. Handling “Flight Crew Member Report”

2. Crew Scheduling Section

The Assignment Management Section (AMB) is staffed with 8 persons including director.

According to Operations Manual of TNA Flight Operations Department, the functions of AMB include:

1. Receiving, issuing and distributing Flight Crew Member Report;
2. Developing flight crew flight schedule and day-to-day flight crew mission schedule;
3. Supervising mission assignment and handling occasional or unusual conditions of pilots;
4. Handling preplanning, statistics and adjustment of pilot flight time;
5. Producing, translating, and receiving/issuing official papers;
6. Producing, translating and publicizing Flight Operations Circular and Fleet Circular; and
7. Maintaining and updating the manuals on aircrafts.

1.17.1.3.2 Standard Training Department

1. Standard Training Section (STS)

STS is staffed with director, one staff member, and a task-based team composed of check pilots and instructor pilots.

According to Operations Manual of TNA Flight Operations Department, the functions of STS include:

1. Revising and enlarging various standard flight operation doctrines such as Standard

Operations Procedures, Flight Operations Manual, Flight Training Management Manual, Flight Training Manual and Route Manual;

2. Collecting and compiling teaching material and questions pool regarding ground academic training, simulator training and flight training of each type of aircraft;
3. Supervising the instructor pilots in conducting training, qualifying techniques and skills, evaluating training results and tracking shortcomings, as well as conducting checks on lag of training progress and events of poor grade examination and raising suggestions;
4. Taking part in the process of selecting and evaluating new pilots and pilots for advanced and transferring training, and attending the fleet manpower appraisal meeting; and
5. Holding meetings to check pilots' flight competence and skills.

According to Operations Manual of TNA Flight Operations Department, the responsibilities of Check pilots and Instructor Pilots of the task-based team include:

1. Conducting checks and tests on various pilot techniques and skills;
2. Implementing various flight trainings (including flight-related ground academic subjects and civil aviation regulations and laws);
3. Reflecting training problems and improving training or operational procedures;
4. Appraising and checking the qualifications of pilots; and
5. Participating regular instructor pilot meetings as well as personnel techniques and skills appraisal meetings.

The Operations Manual of TNA Flight Operations Department states:

1. Section 2-9, "ATR and A320/321 Regular Recurrent Training," of Chapter 2, "Training Procedures and Regulations," has set forth the disciplines and hours of ground academic training that are conducted twice a year, and the cold weather operation procedures class shall be scheduled in the second half year for 1 hour.
2. Section 3-4-5, "Emergency Procedures," of Chapter 3, "Standards of Training and Completing Checks," requires of pilots to make a correct explanation of emergency procedures to judge their expertise which include "icing: 1. airframe; 2. engines."

2. Programming & Training Section

Programming & Training Section (PTS) is staffed with director, deputy director and one staff member.

According to Operations Manual of TNA Flight Operations Department, the functions of PTS include:

1. Developing training programs and tracking the implementation of them.
2. Coordinating with Dispatch Center to arrange the recurrent training of pilots;
3. Safekeeping, sorting out and replenishing training material, books and training equipment;
4. In charge of various flight and ground academic trainings, and collecting and assessing the opinions from instructors and trainees.
5. Arranging trainees for simulator recurrent training and handling information; and
6. Tracking trainees' stage trainings and their examination records.

3. Planning & Development Section

Planning & Development Section (PDS) is composed of a director and one engineer.

According to Operating Manual of TNA Flight Operations Department, the functions of PDS include:

a. Developing flight operation policy, regulations pertaining to aircraft functions, fuel policy, flight programs and related operational procedures;
b. Providing relevant performance information related to establishing new route and charter flight operation;
c. Designing manual-loading and -trimming table for each type of aircraft;
d. Providing engineering database for computer-loading and -trimming table; and
e. Conducting analysis and statistics of flight time and fuel consumption of each type of aircraft in each route.

Remarks on interview records:

A line pilot concurrently holds the post of Standard Training Section (STS) director. The post of Standard Training Department (STD) manager has not been formally filled and is doubled by STS director. The acting STS manager is parallel to director of Academic

Courses Planning Section in rank, and they maintain a communication and coordination relations in operations. STD has no full-time manager.

ATR simulator training is conducted in foreign country, 2 hours for training and a checkride in every half a year. The training is aimed at the requirements and shortcomings while the checkride focused on critical subjects required by civil aviation regulations. The training time is quite tight and it is difficult to complete all courses at one training session. If additional simulator training is required when pilots have failed to pass the test, the coordination for an extra training is difficult.

The simulator technical trainings are based on the teaching material provided by manufacturer that are dispensed in a circle of three years including all normal/abnormal subjects. Also, there are some training that will be added into the courses according to different seasons, environments, and the requirements of different aircraft fleets. In addition, some critical check items and compulsory subjects, such as the approaching procedures for the changed runway 28 in Sungshan Airport, for instance, required by CAA will be included in the courses as well. The training results of each pilot will be recorded and reported backs to CAA every 3 months and will be used as an appraisal item in rating his annual performance. Such subjects include wind shear operation, thunderstorm weather operations, traffic alert and collision avoidance system, and controlled flight into terrain. The basic operations include step turn, stall, etc. All of these subjects are essential in annual tests. The simulator training accounts for only 12 hours in a circle of three years, it is difficult to complete all subjects training within this short period.

Due to a shortage of manpower, there have been flaws on the part of Flight Operations Department in follow-on tracking minor shortcomings found in the school courses tests. Instructor pilots and examiners decide the simulator training subjects. The key training subjects and the essential subjects that must be completed in each half a year are mentioned in instructor pilots meeting and all of them know the key points and standards of each subject. The simulator tests have seen none failing to pass in recent year as there were 3 pilots (not including CM-1) and 1 or 2 first officers narrowly passed the basic school courses tests. They needed to exert more efforts.

The total flight time of ATR fleet pilots in 2000 and before the end of 2001 nearly reached the flight limit of 1,000 hours. The shortage of manpower is apparent. The situation has been improved recently, however, if pilots get ill or take leave, the training will be affected. This has been the part that CAA particularly concerned during in-depth inspections. CAA has demanded TNA to improve in this regard. ATR fleet has recruited a number of new pilots in recent years, but they are uneven in quality. ATR fleet has

launched five echelons of recruitment in 2001, in one of which only one of six candidates is qualified, hence the manpower requirements are unable to be satisfied.

“Icing” is not an individual subject, it varies depending on environmental conditions that needs pilots alertness to cope with. In the ground school course and simulator tests, questions about icing subject have rarely appeared. Nor the severe icing subject have been included in simulator training and test because Taiwan is located in subtropical zone with low possibility of icing, and a severe icing happened in 2002 and was not attached importance. Training for handling severe icing is not emphasized in particular in school courses and technical trainings. A severe icing cannot be reproduced on a simulator, only the methods to handle icing condition are instructed. Therefore, it is not sure that all pilots are aware of the definition and phenomenon of severe icing. Director of Programming Courses Planning Section is responsible for the examination questions of ground school courses that are diversified in category. The examination questions provided by original ATR manufacturer are written in English but some Chinese questions are added into by TNA. The examination questions of school subjects are written in English and, when necessary, other questions will be used to replace the original English questions. School Courses Planning Section is responsible for this task.

The format of Load and Trim Sheet is designed by Planning & Development Section, which is determined and implemented after the dispatchers of System Operation Center gives consent in reply.

1.18 Additional Information

1.18.3 Summary of Interviews

1.18.3.1 A summary of interview with dispatcher

The interviewee was in night shift on December 20, 2002, who was responsible for GE791 flight plan and mission reminder. Around 1900 that evening, he heard a colleague in front of him answered a phone call from CM-2, saying that he was not sure if CM-1, residing in Taoyuan, would report to Sungshan Airport. Then he made a phone call to CM-1 at 1918 for an inquiry and learned that CM-1 would directly report to CKS International Airport and meanwhile, he made the flight crew briefing on the phone.

He then called CM-2, telling him that CM-1 would arrive at CKS International Airport and that a briefing has been made for CM-1. CM-2 arrived at System Operation Center (SOC) at 2140 to receive a briefing and represented CM-1 to sign on Flight Crew Briefing sheet, then took a vehicle at 2200 heading for CKS International Airport.

The SOC operating manual stipulates that all pilots have to report to SOC, Sungshan Airport regardless of performing domestic or international flight, and that after receiving the flight crew briefing, the captain and the dispatcher have to jointly sign the flight plan to suggest that a consensus is reached.

The interviewee revealed that he learned from one of his colleagues that CM-2 contacted SOC at 0200 December 21 via cockpit radio saying the aircraft was just passing through Makung when it was at FL 180, everything is normal.

The interviewee indicated: The contents of the briefing included weather conditions and the visibility at CKS and Macau airports, a 6-hour weather forecast at 1800, and a description of possible rain in both airports with the forecast of minimum visibility 3000m and BR[4]; no special condition was noted in notice to airman, and CM-1 was suggested to take a look at it by himself when available. Attached to the flight crew briefing were weather satellite IR image and upper layer wind information ranged from 2,000ft, 5,000ft, 10,000ft, 15,000ft, to 20,000ft which were printed out from Multidimensional Display System (MDS) of CKS Flight Information Station, in which the temperature data of those altitudes were marked as 20 degrees Celsius at the ground of CKS International Airport, 0 degree Celsius at altitude of 10,000ft and minus16 degrees Celsius at 18,000ft. He told CM-1 to fill with a little more fuel as strong headwind was expected. CM-1 said he got it and ended the phone briefing.

[4] BR is a code representing light fog.

1.18.3.2 A Summary of Interview with Pilots who Operated B22708 One Day before the Accident

Two crewmembers who performed flight GE793 and GE794 (CKS International Airport to/from Macau International Airport) on December 20, 2002, expressed during the interview:

GE794 took off around 2100 carrying over 3,200kg cargo. The planned flight altitude was FL 190, and then requested to climb to FL 230 because of clouds influence, where the static air temperature (SAT) was about minus 18 to 19 degrees Celsius. After passing through Makung, the aircraft flied into clouds but the density of moisture was not thick during the course of descending. Icing condition was encountered along the route but no evident signal of moisture shown in radar screen.

The interviewees indicated that the methods of dealing icing has been instructed in simulator training in the past year, but the ground school training is insufficient and the professionalism of instructors were considered substandard. It is appropriate to employ professional instructors from outside or step up training to develop in-company instructors. It is suggested that the severe icing in Quick Reference Hand Book (QRH) be regulated as a Memory Item.[5]

Two crewmembers who performed flight GE791 and GE792 (CKS International Airport to/from Macau International Airport) on December 20, 2002, expressed during interview:

It was heard before the accident that when flying in bad weather, B22078 still encountered a severe icing even the de-icing system and "-20℃ Switch" had been activated. During which, the aircraft's angle of elevation augmented and airspeed decreased. The pilots requested clearance to descend from FL 180 to FL 140 and the conditions restored to normal after descending. Normally, when B22708 flying and maintaining at FL 180 and using autopilot and cruise power, the indicated airspeed is around 200 kt. TNA Flight Operations Department did not issue special notice in 2002 to remind ATR aircraft pilots of potential icing problem and handling procedures, but AirBus fleet did issue a special notice due to the fleet prepare for the first time flight to a cold weather area.

1.18.3.3 A Summary of Interview with Crew Member who had Flied with the Crew Pilots before the Accident

[5] It refers to the items of emergency processing procedures that have to be memorized and recited by pilots.

The pilot who flied with CM-1 on the last flight before the accident indicated:

They performed Sung Shan→Makung→Kaohsiung→Makung→Kaohsiung passenger flight missions in the afternoon, December 17, 2002. It was about 2000 when they arrived at Kaohsiung and stayed overnight at Kaohsiung. About 0810 the next day, 18, they performed Kaohsiung→Makung→Kaohsiung→Makung→Sung Shan passenger flight missions and were off duty around 1200. The flights during the two days were normal without any special condition, and CM-1's sentiments and operation were all sound and normal.

The pilot who flied with CM-1 on the last second flight before the accident indicated:

In the afternoon, December 14, 2002, they performed 4 two-way passenger flights between Sung Shan and Hualian and those operations were all normal. The interviewee considered CM-1's performance prudent and no abnormal condition had been noted in previous co-working.

The pilot who flied with CM-1 on CKS—Macau two-way freighter flight before the accident indicated:

The weather was fine and the flight operation normal on December 10, 2002. The anti-icing and de-icing equipment were not activated. Another pilot who flied with CM-1 on the CKS—Macau two-way freighter mission before the accident indicated: He reported to Sungshan airport on November 21 and 22, 2002, and SOC told him that CM-1 would directly report to CKS International Airport, hence the dispatcher made a briefing to him who in turn made the briefing to CM-1 after his arrival at CKS International Airport. He also handed the whole package of flight plan over to CM-1. CM-1 read it in guest room. When a staff member told him that cargo was all loaded, CM-1 asked to fill with additional fuel to upper limit, i.e. about 2,800kg. The two-way flights were normal.

The pilot who flied with CM-2 on the last flight before the accident indicated:

At 2000, December 17, 2002, they performed passenger flight mission from Sungshan to Hualian and stayed overnight there. They performed passenger flight mission from Hualian back to Sungshan. CM-2 was the pilot flying (PF) on both missions, and his performance both in the air and in landing met with requirements. His mentality and sentiments were nothing abnormal. He was off duty after landing at Sung Shan Airport. The interviewee conceived CM-2 brilliant, prudent and stable in flight performance.

The pilot who flied with CM-2 on the last second flight before the accident indicated:

They performed four two-way flights on passenger flight between Sungshan and Hualian, 8 flights in total. CM-2 was the pilot flying in 6 of them and his performance was normal.

The pilot who flied with CM-2 in CKS—Macau two-way freighter before the accident indicated:

The weather conditions were stable on 22 and November 23, 2002, the interviewee especially reminded CM-2 of cargo payloads and fueling condition, and asked him to keep informed of information about high altitude wind, unstable airflow area and altitude of icing during the flight crew briefing. CM-2 was well prepared and had solid expertise in these regards. He had a clearer awareness about the flight route than other first officers and was able to fully identify the checkpoints in or near the route. He frequently checked with the flight plan and flight chart throughout the flight. He had no problem in jotting down and responding to Air Traffic Control's permissions. And he demonstrated a good capability in staying alert to conditions and in controlling aircraft throughout the flight mission. The interviewee conceived that CM-2's professionalism met with the standards and he was modest in getting along with people.

1.18.3.4 A Summary of Interview with Simulator Examiner and Check Pilot on Route Check

The CAA designated examiner who conducted the latest simulator rating to CM-1 and was the same examiner who conducted the latest rating to CM-2 indicated:

He conducted the simulator rating to CM-1 and CM-2 on June 23 and July 25, 2002, respectively. The performance of both pilots was not excellent but was falling within qualifying standards. They passed the rating.

CM-1 was a little slow in reacting to emergent conditions in simulator recurrent training and not so good on such subjects as basic operation flight, single engine go-around, and instruments cross check and scanning.

CM-2 was not so familiar with "system knowledge" and "standard call out". For example, for the item of low oil pressure, he could not tell and test whether the signals were false.

In reference to the training records, the interviewee recalled to mind something about CM-1's simulator training and subjects: 1. No question about autopilot approaching; 2. An evident deviation from flight track occurred during basic operation flight. The

performance was not good, but it was gradually improved after reminded by pilot not flying (PNF); 3. Crosscheck and scanning was slow; 4. When approaching with single engine, the same event during basic operation flight happened; and 5. Same event happened during single engine go-around. As for CM-2, he was apt to omit procedural call out and system (procedures), but it was not a problem after he finally got it. The appraisal ratings of CM-1's and CM-2's reactions were slow and normal respectively. Though there were shortcomings in CM-1's training, they all fell within the norms after reminded by PNF.

The check pilot who conducted the latest route check to CM-1 indicated:

A route check to CM-1 was conducted on June 11, 2002. He passed the check and he demonstrated a good control capability in a thundershower condition. He held a same test to CM-1 on February 19, 2001, and a Shortcoming Notice was issued to him. The interviewee also recalled to mind that CM-1's performance was unstable on basic operation flight and single engine flight under low visibility condition during simulator training. CM-1's performance had become steady after he and the interviewee reviewed the operation guidelines together and special simulator flight training was conducted for CM-1.

The check pilot who conducted the latest route check to CM-2 indicated:

A route check to CM-2 was conducted on June 3, 2002. He passed the check.

1.18.3.5 A Summary of Interview with an ATR72 Pilot who has Encountered Severe Icing

The interviewee described the course of the event:

In late November 2002, he performed GE793 (Taipei to Macau) freighter. His aircraft climbed to FL 180 around 1100 and encountered a severe icing before reaching ELATO[6]. He immediately requested descend to FL 140. The aircraft carried a full payload and was climbing at indicated airspeed 170 kt after takeoff from CKS International Airport. Icing occurred when it flied through FL 140. The climbing rate was 500ft/min between FL 150 and 160. When the climbing rate was lower than 500ft/min, the Engine Power Management System was adjusted to Maximum Continuous (MTC) position.

The aircraft was passing through cloud intermittently, which was thick before the

[6] In route A-1, the significant point on the border of Taipei and Hong Kong Flight Information Region is located at 140 nautical miles southwest of Makung VOR/DME.

aircraft reached ELATO. During level flight, everything was fine while he continued watching the functioning status of de-icing boots. After a while, the nose was found elevated and the airspeed slowed down. The cruise airspeed reduced from indicated airspeed 200 kt to close to but not lower than red bug. When the airspeed was lower than 190 kt, a request for descending altitude was already made to Air Traffic Control and then the autopilot was disengaged and the manual operation was performed in stead to descend. At this point, the Engine Power Management System was moved to MCT position. The descending rate was 1,400ft/min. When descending to FL 160 and the indicated airspeed was 220kt, the control wheel was normal. The airspeed could be maintained though the aircraft was still within the clouds. Therefore, clearance was obtained from Air Traffic Control to maintain at FL 160.

The interviewee noted as he recalled: It happened around 15 to 20 seconds from nose elevation, gradually reduced airspeed to requesting permission to descend. This was the first severe icing he encountered. He regarded it as a valuable experience worth sharing. He told every colleague he met about this event and mentioned it in crew standby room, but didn't write a report.

1.18.3.6 A Summary of Interview with Clerk

The interviewee began to work with TNA in April 1999, and was transferred to CKS International Airport as a TNA clerk in July 1, 2002, and on 26 the same month he was transferred to the position of preparing Load and Trim sheet. A training course for this job was finished on August 14. He was approved by the Company to start the work of preparing Load and Trim sheet. In addition to working for TNA, his work included preparing Load and Trim sheet for a foreign Airline.

The interviewee prepared Load and Trim sheet for the aircraft on December 20, 2002, according to the loading Instruction/Report transmitted to him from TNA Freight Section, the operational flight planning delivered by System Operation Center and the takeoff fuel requested by captain. CM-1 and CM-2 arrived at TNA office in CKS International Airport about 2310. According to the operational flight planning, the original takeoff fuel was 2,812kg, but CM-1 requested it be added to 3,000kg. After the Load and Trim sheet was finished, a photocopy of it, signed by CM-1, together with the operational flight planning and the weather data provided by CKS System Operation Station were handed over to CM-1, but oral briefing was not made.

Around 0035, 21st, loading worker at cargo apron transmitted a message saying the loading process would be finished within five minutes. At this point, both of the pilots took a vehicle to cargo apron 508. He saw the two pilots (note: that both of them did it

at the same time was stressed) walking around the aircraft to have a visual check after they were at the apron.

When the loading operation finished, the door was closed, and engines started. The aircraft was pushed backwards, then the interviewee drove back to his office, it was 0055, 21st.

1.18.3.7 A Summary of Interview with the Load Master who prepared and supervised the Loading Instruction

The interviewee was a loadmaster of TNA Freight Section at CKS International Airport who began to work with TNA in April 1993, and was transferred on borrowing to do the present job in March 2002.

The operation conditions of TNA freighters: The B22708 was converted into an all-Freighter in February 2002. It performed 2 two-way freighters between CKS International Airport and Macau International Airport on a daily basis except Monday. Hazardous materials are prohibited from the Freighter. The flight schedule of this aircraft was as follows:

- GE 791: TPE 0030→MAC 0300;
- GE 792: MAC 0500→TPE 0730;
- GE 793: TPE 0930→MAC 1200;
- GE 794: MAC 2030→TPE 2230; (It was changed to MAC 1845→TPE 2115 on Sundays)

About 2200, December 20, preparation of Loading Instruction began and was finished at about 2310. He notified the TNA worker at CKS International Airport who was in charge of preparing Load and Trim sheet. Also, a certain ground services company (hereinafter referred to as “G Company” was notified too. And then he went to cargo apron 508 to look round for the loading operation which was completed at about 0040 next morning.

The interviewee described the operation of that day as follows:

At first, he checked the cargo according to Cargo Deadlock Sheet to make sure they were cleared for moving. Most of the cargo for night flight were express cargo which were moved into storehouses late in the day, mostly were after 2200. The express cargo, which has to be weighed first before moved into storehouses, has markings of number of pieces and weight on their exteriors. A Loading Instruction/Report was

prepared according to the data aforementioned. This aircraft carried 459 pieces of item that were mounted to 6450kg of total payload. After calculating the takeoff fuel requested by captain and checking with index table, the actual takeoff weight of the aircraft was within the range of safety. When the Load and Trim sheet was finished without question, the Loading Instruction was handed over to G Company. The loading operation started at 1120, 20th, the cargo was counted first, and then divided into six stacks. The interviewee accompanied the foreman of G Company to check the bill of lading (B/L) number and total pieces according to cargo logo to ensure that all cargo were in place and loaded according to the Loading Instruction/Report. After the loading operation was done, he went on board to check the direction of cargo piling, and pull tight and fasten the cargo holding net. No glitch was noted. He went off board after re-confirming that the loading plan had been implemented exactly.

1.18.3.8 A Summary of Interview with Cargo Loading Workers

1.18.3.8.1 A Summary of Interview with Cargo Loading Foreman and Workers

The foreman and workers (13 persons in total) of G Company who carried out GE791 cargo loading operation were interviewed respectively. A summary of these interviews were summarized as follows:

After delivery of the Cargo Deadlock Sheet to G Company's office, the foreman drove a truck to the storehouse to pick up the cargo and transported them to the side of the aircraft. Loading workers are responsible for counting the number of pieces only, not for inspecting cargo weight. But there is a weight indication on each piece of cargo according to rules. He has learned about hazardous material in class and knows what specific marks indicate hazardous material. No hazardous material was in the aircraft that day. The operator of cargo conveyer is responsible for counting cargo by checking with the cargo number.

The foreman monitored the loading operations at the side of the aircraft according to Loading Instruction/Report, who checked the cargo number when loading, as there were a cargo number and item number on each piece of cargo. Hands preformed loading operation, as the roller conveyer didn't help much. In principle, heavier cargo was placed underneath, while irregularly packed cargo in the middle. In his recall, the cargo that day was heavy. The fabric was placed on the bottom and fastened by adhesive tape in Bay No. 13, and cases were piled on the top. The cargo in each bay was disposed to form a square and was fastened by holding net according to requirements. There are four retainer rings on the long side of the net and three on the

short side. After the rings were fixed, the independent strips on four sides were pulled tight and knotted (when pulling tight is not possible, a spare rope could be used to strengthen). The foreman boarded the aircraft after all cargo had been loaded to inspect and assist in fastening work. Staff members of TNA would get on the aircraft for a final check. The loading operations were all normal, no adjustment of cargo was made, and no dispute among the team.

1.18.3.8.2 A Summary of Interview with Chief of Loading Operation Unit

He entered a ground services company in 1974 and has been doing the loading/unloading job since then. His new member trainings started from academic courses including environment, company interior rules, identification of luggage and cargo tags, and hazardous material. Senior officer who include opening/closing holds technical courses the doors of different type of aircraft, placing the roadblock, etc. Two years later, they will take trainings and tests for driver licenses of small bus, cargo conveyer, and tow tractor. After another two years, they may take trainings and tests for driver license of belly compartment loader, cabin loader, etc. depending on company's requirements The driver who operates vehicles above the tow tractor class will be disqualified if he fails to pass the training or violates relevant regulations.

Training on hazardous material is conducted every year while the technical training on an irregular basis. The responsibilities of foreman are counting cargo according to loading listing and the driver of tow tractor is responsible for towing cargo according to the listing and helping foreman to move cargo onto the conveyer. People on board will place the cargo in order. Leader of the group will inspect irregularly to see if the operations are all in compliance with requirements. Loosening, slacking or the like of cargo in flight has never been heard of.

1.18.3.9 A Summary of Interview with CAA Principal Operations Inspector

In early 2001, CAA designated a principal operation inspector (POI) in TNA. The POI conducted a random cockpit en-route check on CM-1, in which CM-1's flight skills and performance met the requirements of Standard Operation Procedures (SOP) and TNA. The interviewee recalled that during a TNA's instructor pilot meeting, the improvement on CM-1's simulator ratings with his past shortcomings was brought up and discussed.

There are two designated examiner simulator checking a year to foreign countries by CAA. The monthly instructor pilot meeting also serves the purpose of examining the

results of simulator rating carried out in the previous month. The inspection focuses on pilot's performance including operation procedures and skills to see if the SOP is complied with. The pilot's annual route check includes oral test.

A recurrent training for pilots who have had finished their trainings is conducted once in half a year, the ground courses includes laws and regulations, flight information, JEPPESEN charts. The recurrent training can't cover all academic subjects at one session; instead these subjects shall be allocated in coordination with the simulator skill courses so that they can be all covered in a period of two years. The inspection on pilot's academic courses focuses on whether they attend classes as required, whether the contents of the courses meet the requirements, whether a test is given and whether they have passed the test.

ATR fleet is operating short-range air transportation in regional area, the pilots are quite familiar with. ATR pilots feel inferior as they receive unequal pay and treatment compare to another fleet, which in turn lead to an unbalanced mentality. Their faith to the Company is weak. They are lax in fulfilling the requirements of the Company. Leader of this fleet shall make efforts to enhance pilots' enterprising spirit by means of raising their pay and adjusting their workload and time for rest. (In 2001, annual flight time of pilots had been close to upper statutory limits at the end of that year due to manpower shortage.)

In saving costs, the time frame of simulator training in foreign countries is tightened and the new employed personnel are not able to learn what they need in a short period. The time frame for up-grade training is even tightened which has an impact on the quality of training.

The interviewee believed that he had a deep understanding about TNA and that the management level was not rendering sufficient support to the pay raise and workload reduction of first line personnel. Pilots of ATR fleet staged a strike in 1999 when their pay was cut down substantially. The strike posed a significant impact.

1.18.3.10 A Summary of Interview with Flight Crew who were Flying in Nearby Area when the Accident Took Place

The two interviewees were captain and first officer of a certain airline who indicated:

They lifted from Honk Kong international airport at 0119, December 21, 2002, and climbed to FL 270 via A-1 heading for their destination CKS International Airport. About 20 nautical miles before ELATO, they requested for permission to climb to FL 330 due to weather conditions and in the meantime entered M-750 local flight route. The wind

direction was 260 degrees and wind speed 90 kt at FL 330. They heard SOS signals before flying through TONGA[7], and immediately told Taipei Control Center. After that, they began descending and approaching. The altitude of clouds ceiling was about 30,000 ft. They encountered turbulence, into cloud and rain when descending, but no lightening. The weather radar screen showed green, and no purple, red or yellow colors were noted. When descended to about 800 ft, the aircraft flied out of cloud.

[7] M-750 local flight route is a key point on the border of Flight Information Region, which is located at Makung azimuth 187 degree, 25.3 nautical miles.

1.18.4 Information about "Severe Icing"

1.18.4.1 Airplane Flight Manual

1 . 02 . 01 – DEFINITION OF WORDING

Note	: An operating procedure, technique etc... considered essential to emphasize
CAUTION	: An operating procedure, technique etc... which may result in damage to equipment if not carefully followed
WARNING	: An operating procedure, technique etc... which may result in injury or loss of life if not carefully followed.

1 . 02 . 02 – UNIT CONVERSION

Weight	1 kg = 2.2046 lb	1 lb = 0.4536 kg
R Length – Altitude R Distance	1 m = 3.2808 ft 1 m = 39.3701 in	1 ft = 0.3048 m 1 in = 0.0254 m
Pressure	1 HPa = 0.0145 psi	1 psi = 69 HPa
Temperature	1° C = (1° F – 32) x .555	1° F = 1° C x 1.8 + 32

2 . 06 . 01 – ICING CONDITIONS (cont'd)

- **Severe icing :**

WARNING :

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

– During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following :

Visual cue identified with severe icing is characterized by ice covering all or a substantial part of the unheated portion of either forward side window, possibly associated with water splashing and streaming on the windshield.

and / or

Unexpected decrease in speed or rate of climb.

and / or

The following secondary indications :

. Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.

. Accumulation of ice on the lower surface of the wing aft of the protected area.

. Accumulation of ice on the propeller spinner farther aft than normally observed.

If one of these phenomena is observed, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions. Apply procedure specified in the Emergency Procedures chapter.

– Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when the severe icing defined above exists, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.

2 . 06 . 01 – ICING CONDITIONS

- **Atmospheric icing conditions exist when**
  - OAT on the ground and for take–off is at or below 5°C or when TAT in flight is at or below 7°C,
  - and visible moisture in any form is present (such as clouds, fog with visibility of less than one mile, rain, snow, sleet and ice crystals).

- **Ground icing conditions exist when**
  - OAT on the ground is at or below 5°C,
  - and surface snow, standing water or slush is present on the ramps taxiways and runways.

Take–off is prohibited when frost, snow or ice is adhering to the wings, control surfaces or propellers.

- Operation in atmospheric icing conditions :

R **NP setting below 86 % is prohibited.**

All icing detection lights must be operative prior to flight at night .

NOTE :This supersedes any relief provided by the Master Minimum Equipment List (MMEL).

The ice detector must be operative.

Refer to 3.04.01 for associated procedures and 6.06.02 for performance data.

R - Operation in ground icing conditions :

Refer to 3.04.01 for associated procedures and to FCOM part 3 and to AFM section 7.03 for advisory information on contaminated runways penalties.

.../...

3 . 04 . 01 – ICING CONDITIONS

• DEFINITION
Refer to 2 .06 .01

Procedure for operation in atmospheric icing conditions :

• As soon as and as long as atmospheric icing conditions exist, the following procedures must be applied :
ANTI–ICING (propellers, horns, side–windows) ..... ON
PROP MODE SEL ..... According to SAT
NP ..... set ≥ 86 %
Minimum maneuver/operating
icing speed ..... BUGGED AND OBSERVED
ICE ACCRETION ..... MONITOR

NOTE : horns anti icing selection triggers the illumination of the "ICING AOA" green light, and lowers the AOA stall warning threshold.

R • At first visual indication of ice accretion and as long as atmospheric icing conditions exist, the following procedure must be applied :
– ENG START rotary selector ..... CONT RELIGHT
– ANTI ICING (propellers, horns, side windows) ..... CONFIRM ON
– DE ICING ENG 1 + 2 ..... ON
– AIRFRAME DE ICING ..... ON
– Eng and airframe MODE SEL ..... ACCORDING TO SAT
– Minimum maneuver/operating
icing speed ..... CONFIRM BUGGED AND OBSERVED

NOTE : Be alert to severe icing detection.
In case of severe icing refer to Emergency Procedures 4.05.05.

R • When leaving icing conditions, CONT RELIGHT, DE ICING and ANTI ICING may be switched OFF.

• When the aircraft is visually verified clear of ice, ICING AOA caption may be cancelled and normal speeds may be used.

NOTE : Experience has shown that the last part to clear is the ice evidence probe. As long as this condition is not reached the icing speeds must be observed and the ICING AOA caption must not be cancelled.

4 . 05 . 05 – SEVERE ICING

DETECTION

Visual cue identified with severe icing is characterized by ice covering all or a substantial part of the unheated portion of either forward side window, possibly associated with water splashing and streaming on the windshield.

and / or

Unexpected decrease in speed or rate of climb.

and / or

The following secondary indications :

- Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
- Accumulation of ice on the lower surface of the wing aft of the protected area.
- Accumulation of ice on the propeller spinner farther aft than normally observed.

The following weather conditions may be conducive to severe in flight icing :

- Visible rain at temperatures close to 0 degrees Celsius ambient air temperature.
- Droplets that splash or splatter on impact at temperatures close to 0 degrees Celsius ambient air temperature

EXIT THE SEVERE ICING ENVIRONMENT :

This procedure is applicable to all flight phases from initial climb to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as –18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present.

■ **If severe icing, as determined above, is encountered :**

–Immediately increase and bug the minimum maneuver/operating icing speeds by 10 kt. Increase power up to MAX CONT, if needed.

–Request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.

–Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

4 . 05 . 05 – SEVERE ICING (Cont'd)

- Do not engage the autopilot.

- **If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.**

- **If the flaps are extended, do not retract them until the airframe is clear of ice.**

- **If an unusual roll response or uncommanded roll control movement is observed maintain the roll controls at the desired position and reduce the angle of attack by :**

  - Pushing on the wheel as needed,

  - Extending flaps to 15,

  - Increasing power, up to MAX CONT if needed.

- **If the aircraft is not clear of ice :**

  - Maintain flaps 15 for approach and landing, with "reduced flaps APP/LDG icing speed"+ 5 kt.

R - Multiply landing distance flaps 30 by 1.91

- Report these weather conditions to Air Traffic Control

1.18.4.2 Flight Crew Operating manual

AA

This chapter is divised in three parts :

- Icing,
- Cold weather operations,
- R - Operations in wind conditions.

ICING

I - GENERAL

Icing conditions are defined as follows :

▶ Atmospheric icing conditions

Atmospheric icing conditions exist when OAT on ground and for take-off is at or below 5°C or when TAT in flight is at or below 7°C and visible moisture in the air in any form is present (such as clouds, fog with visibility of one mile or less, rain,
R snow sleet and ice crystals).

▶ Ground icing conditions

Ground icing conditions exist when the OAT is at or below 5°C when operating on ramps, taxiways and runways where surface snow, standing water or slush is present.

▶ Regulatory requirements

Certification requirements defined in JAR/FAR 25 appendix C consider droplet sizes up to 50 microns in diameter. No aircraft is certified for flight in conditions with droplets larger than this diameter.

However, dedicated flight tests have linked unique ice accretion patterns to conditions of droplet sizes up to 400 microns. Procedures have been defined in case of inadvertent encounter of severe icing.

▶ Organization of this subchapter

It will address the following areas :

- Operations within the certified envelope.
- Information about severe icing beyond the certified envelope.
- Good operating practices.

II – OPERATIONS WITHIN THE CERTIFIED ICING ENVELOPE

PREAMBLE

Icing conditions should never be assessed with complacency. Although the aircraft is adequately protected for most of the encountered cases, any severe icing exposure should be minimized by a correct evaluation and proper avoiding actions.

A) GENERAL

Operations in atmospheric icing conditions require SPECIAL ATTENTION since ice accretion on airframe and propellers SIGNIFICANTLY modifies their aerodynamic characteristics.

The primarily considerations are as follows :

a – Even small quantities of ice accretions, which may be difficult to detect visually, may be sufficient to affect the aerodynamic efficiency of an airfoil. For this reason, ALL ANTI ICING PROCEDURES and SPEED LIMITATIONS MUST BE COMPLIED WITH as soon as and as long as ICING CONDITIONS are met and even before ice accretion actually takes place.

b – Main effects of ice accretion on airfoils are :

- Maximum achievable LIFT is reduced.
- For a given angle of attack, LESS LIFT and MORE DRAG are generated. In order to maintain a SAFE MARGIN AGAINST STALL, which will occur at a higher speed when ice accretion spoils the airfoil :
  - the stall warning threshold must be reset to a lower value of angle of attack,
  - the stick pusher activation threshold is lowered accordingly.

These lowered thresholds are effective when switching horns anti icing ON and illuminating the ICING AOA green caption.

THE LOWER AOA OF STALL WARNING THRESHOLD AND THE LOWER STICK PUSHER ACTIVATION THRESHOLD DEFINED FOR ICING REMAIN ACTIVE AS LONG AS THE « ICING AOA » CAPTION IS ILLUMINATED.

– Accordingly, the minimum maneuver / operating speeds defined for normal (no icing) conditions (see FCOM 2.02.01) MUST BE INCREASED.
These new minimum speeds are called « MINIMUM ICING SPEEDS ». They are defined further in paragraph B.

AA

III - SEVERE ICING

A) GENERAL

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. All the ice not shed by using the ice protection systems may seriously degrade the performance and controllability of the airplane.

B) CONDITIONS OF FORMATION

The airplane is certificated for a range of droplet diameter, a range of icing temperature and a range of water content in the icing cloud.
If one or more of these main parameters is exceeded, the flight is performed outside the certification frame.
Three phenomena may lead to surpass the ice protection capabilities :

1) Mechanical phenomenon : droplet diameter

The droplet diameter may be up to 3 to 30 times greater than the upper limit of the certification envelope in freezing drizzle/freezing rain conditions. The inertia of droplets is such that the ice may cover all the frontal surface of airfoil exposed to the cloud, outside of the protected areas.
Depending on the angle of attack of the airfoil, a ridge may form mainly on the upper side of the airfoil (e.g. flaps 15) or a granular pattern may accrete on the lower surface of the airfoil up to 50 % of the chord (e.g. flaps 0).
Freezing rain and freezing drizzle conditions are found typically at low altitudes with a static air temperature around – 4°C (3000 ft) and associated with temperature inversion.
However, freezing drizzle conditions may be found at higher altitudes (up to 15000 ft) with a static air temperature down to – 18°C. They may be the consequence of the turbulence effect which leads to a coalescence process of small droplets into large droplets. It may be encountered on top of stratiform clouds.

2) Thermal phenomenon : skin temperature and/or liquid water content

When the flight in icing conditions is such that the total air temperature is above 0°C with a static air temperature close to 0°C, droplets cannot freeze on the leading edge because the skin temperature is positive, they roll along the chord till they encounter a surface at a negative temperature. The leading edge is free of ice but a ridge or rivelets may be formed aft of the protected areas. The rivelets are oriented in the airstream direction. They accrete on the lower and upper surfaces.
This phenomenon may occur also with colder temperatures but when a large amount of water is present in the cloud. The structure of the leading edge is not cold enough to freeze the whole water amount and the remaining droplets freeze with delay behind protected parts.

AA

3) Mixed icing condition

Mixed icing condition may be encountered in the range of temperatures −10°C/0°C. It is basically an unstable condition, it is extremely temperature dependent and it may change quite rapidly. This condition may surpass the ice protection capabilities because the aggregate of impinging ice crystal/snow and water droplet can adhere rapidly to the airframe surpassing the system capabilities to shed ice, causing significant reduction in airplane performance as in case of system failure.

C) CONSEQUENCES OF SEVERE ICE ACCRETION

The consequences of severe ice accretions are ice location dependent.

If the pollution extension occurs on the lower surface of the wing, it increases the drag and the airplane speed decreases. It may lead to stall if no action is taken to recover a correct speed.

If the pollution occurs first on the upper part of the wing, the drag is not affected noticeably but controllability anomalies may be encountered.

Severe roll anomalies may be encountered with "flaps 15" accretions flown with flaps 0 setting. It should be emphasized that it is not the flaps 15 configuration itself that is detrimental, but the low angle of attack that may result from such a setting, especially close to VFE. This low or negative AOA increases the wing upper side exposure to large droplet impingement. This is why holding with any flaps extended is prohibited in icing conditions (except for single engine operations).

R

.../...

R **D) DETECTION**

– During flight, severe icing conditions that exceed those for which the airplane
R is certificated shall be determined by the following :

Severe icing is characterized by ice covering all or a substantial part of the unheated portion of either forward side window, possibly associated with water splashing and streaming on the windshield.

Note : This cue is visible after a very short exposure (about 30 seconds). At night, this pattern is put forward by the pilot's reading lights oriented towards the side window.

R and / or

R | Unexpected decrease in speed or rate of climb |

R and / or

R The following secondary indications :
. Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
. Accumulation of ice on the lower surface of the wing aft of the protected areas.
. Accumulation of ice on the propeller spinner farther aft than normally observed.

– The following weather conditions may be conducive to severe in–flight icing :
R . Visible rain at temperatures close to 0°C ambient air temperature (SAT).
. Droplets that splash or splatter on impact at temperature close to 0°C ambient air temperature (SAT).

– The occurence of rain when SAT is below freezing temperature should always trigger the alertness of the crew.

R | EXIT THE SEVERE ICING ENVIRONMENT |

There are no regulatory requirements to certify an aircraft beyond JAR/FAR 25 Appendix C. However, in case of inadvertent encounter with such conditions "severe icing" procedure must be applied (refer to 2.04.05).

AA

IV – GOOD OPERATING PRACTICES

Aircraft certification requirements describe the icing conditions likely to be encountered in commercial aviation. However, as demonstrated by experience, icing remains one of the major causes of incidents and accidents, and good airmanship prohibit any complacency in this area.

The following basic rules should therefore be applied :

- ▶ Know as much about your operating environment as you can.
  Carefully review weather packages for Pilot reports of icing conditions, tops reports, temperatures aloft forecasts and forecasts of icing, freezing drizzle and freezing rain. Monitor both Total Air Temperature and Static Air Temperature during climb and while en route. Use the weather radar. Areas of precipitation which will paint on the radar will be of sufficient droplet size to produce freezing rain when encountered in freezing temperatures or on a cold soaked aircraft.
- ▶ Marginal freezing temperatures and icing conditions should create a heightened state of awareness. Remember, severe ice can still be incurred at temperatures down to approximately – 18° C, at high altitude.
- R ▶ Be alert to severe icing cues defined pages 12/13.
- R ▶ When severe icing is encountered, take appropriate steps to leave the conditions. Since these unique conditions are usually small in area and associated with very specific temperatures conditions, a change in altitude of just a couple thousand feet may place you in a totally different environment.
- ▶ Make reports to ATC and Company.
  There is no better operational tool available today than first hand reports of these conditions. Remember that because these are localized areas and extremely temperature dependent, another aircraft passing through the same area at a different airspeed may experience different conditions. For example, a laboratory test showed for a specific, yet normal condition, rime ice up to about 150 kt, mixed ice as speed was increased to about 200 kt, glaze ice between 200 and 360 kt, and no accretion above 360 kt.

  Note : *Reporting of icing conditions as defined in the FAA's Airman's information Manual (AIM) :*

  ***Trace** : Ice becomes perceptible. Rate of accumulation is slightly greater than the rate of sublimation. It is not hazardous even though de–icing/anti–icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).*

  ***Light** : The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of de–icing/anti–icing equipment removes/prevents accumulation. It does not present a problem if the de–icing/anti–icing equipement is used.*

  ***Moderate** : The rate of accumulation is such that even short encounters become potentially hazardous and use of de–icing/anti–icing equipment or flight diversion is necessary.*

  ***Severe** : The rate of accumulation is such that de–icing/anti–icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.*

GENERAL

The emergency procedures have been established for application in the event of a serious failure. They are applied according to the « READ AND DO » principle except for memory items.

PRESENTATION

The procedures are presented in the basic checklist format with an adjacent expanded part which provides :
- indication of the particular failure (alert condition)
- explanation for actions where the reason is not self evident
- additional background information.

The abbreviation used are identical to the nomenclature on the cockpit panels. All actions are printed in capital letters.

Memory items are BOXED for identification.

If actions depend on a precondition, a preceding black square ■ is used to identify the precondition.

A preceding black dot • is used to indicate the moment when actions have to be applied.

TASK SHARING

For all procedures the general task sharing stated below is applicable.
The pilot flying remains pilot flying throughout the emergency procedure.

PF – Pilot flying — Responsible for :
- . PL
- . Flight path and airspeed control
- . Aircraft configuration
- . Navigation

PNF – Pilot non flying — Responsible for :
- . Check list reading
- . Execution of required actions
- . Actions on OVHD panel
- . CL
- . Communications

The AFCS is always coupled to the PF side (CPL selection).

AA

PROCEDURES INITIATION

- No action will be taken (apart from depressing MW pb):
  . Until flight path is stabilized.
R . Under 400 ft above runway (except for propeller feathering after engine failure during approach at reduced power if go around is considered).

- Before performing a procedure, the crew must assess the situation as a whole, taking
R into consideration the failures, when fully identified, and the constraints imposed.

ANALYSIS OF CONSEQUENCES OF A FAILURE ON THE FLIGHT

Basic airmanship calls for a management review of the remaining aircraft capabilities under the responsability of CM1.

CCAS

When TO INHI has been selected, until the first leg of landing gear unlocks, all alerts are inhibited except:

- ENG 1 FIRE
- ENG 2 FIRE
- CONFIG
- FLAPS UNLK
- LDG GEAR NOT DN
- EXCESS ALT
- PITCH DISCONNECT
- PROP BRK

AA

SEVERE ICING

This procedure is applicable to all flight phases from initial climb to landing.
Monitor the ambient air temperature (SAT).
While severe icing may form at temperatures as cold as - 18°C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

DETECTION

Visual cue identified with severe icing is characterized by ice covering all or a substantial part of the unheated portion of either forward side window, possibly associated with water splashing and streaming on the windshield.

and / or

Unexpected decrease in speed or rate of climb

and / or

The following secondary indications :

. Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
. Accumulation of ice on the lower surface of the wing aft of the protected areas.
. Accumulation of ice on the propeller spinner farther aft than normally observed.

- The following weather conditions may be conducive to severe in-flight icing :
  . Visible rain at temperatures close to 0°C ambient air temperature (SAT).
  . Droplets that splash or splatter on impact at temperature close to 0°C ambient air temperature (SAT).

PROCEDURE

SEVERE ICING

■ **If severe icing as determined above is encountered accomplish the following :**
- Immediately increase and bug the minimum maneuver/operating icing speeds by 10 kt. Increase power, up to MAX CONT if needed
- Request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.

■ **If the autopilot is engaged,** hold the control wheel firmly and disengage the autopilot.

■ **If the flaps are extended**, do not retract them until the airframe is clear of ice.

■ **If an unusual roll response or uncommanded roll control movement is observed,** maintain the roll controls at the desired position and reduce the angle of attack by :
- Pushing on the wheel as needed,
- Extending flaps to 15,
- Increasing power, up to MAX CONT if needed.

■ **If the aircraft is not clear of ice :**
- Maintain flaps 15, for approach and landing, with "reduced flaps APP/LDG icing speed "+ 5 kt.

R
- Multiply landing distance flaps 30 by 1.91

- Report these weather conditions to Air Traffic Control.

AA

COMMENTS

R
- Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when the severe icing defined above exists, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.

- Due to the limited volume of atmosphere where icing conditions usually exists, it is possible to exit those conditions either :

  . by climbing 2000 or 3000 ft, or
  . if terrain clearance allows, by descending into a layer of air temperature above freezing, or
  . by changing course based on information provided by ATC.

1.18.4.3 Quick Reference Hand Book

ATR 72	EMERGENCY Eng : PW124	1.09 JUL 00 | 001

SEVERE ICING

This procedure is applicable to all flight phases from initial climb to landing.
Monitor the ambient air temperature (SAT).
While severe icing may form at temperatures as cold as –18°C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

DETECTION

Visual cue identified with severe icing is characterized by ice covering all or a substantial part of the unheated portion of either side window, possibly associated with water splashing and streaming on the windshield.

and / or

Unexpected decrease in speed or rate of climb.

and / or

The following secondary indications :

.Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
.Accumulation of ice on the lower surface of the wing aft of the protected areas.
.Accumulation of ice on the propeller spinner farther aft than normally observed.

The following weather conditions may be conducive to severe in–flight icing :

.Visible rain at temperatures close to 0°C ambient air temperature (SAT).
.Droplets that splash or splatter on impact at temperature close to 0°C ambient air temperature (SAT).

PROCEDURE

■ **If severe icing as determined above is encountered, accomplish the following :**
–Immediately increase and bug the minimum maneuver/operating icing speeds by 10 kt. Increase power up to MAX CONT if needed.
–Request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions.
–Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
–Do not engage the autopilot.

■ **If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.**

■ **If the flaps are extended, do not retract them until the airframe is clear of ice.**

■ **If an unusual roll response or uncommanded roll control movement is observed, maintain the roll controls at the desired position and reduce the angle of attack by :**
–Pushing on the wheel as needed,
–Extending flaps to 15,
–Increasing power, up to MAX CONT if needed.

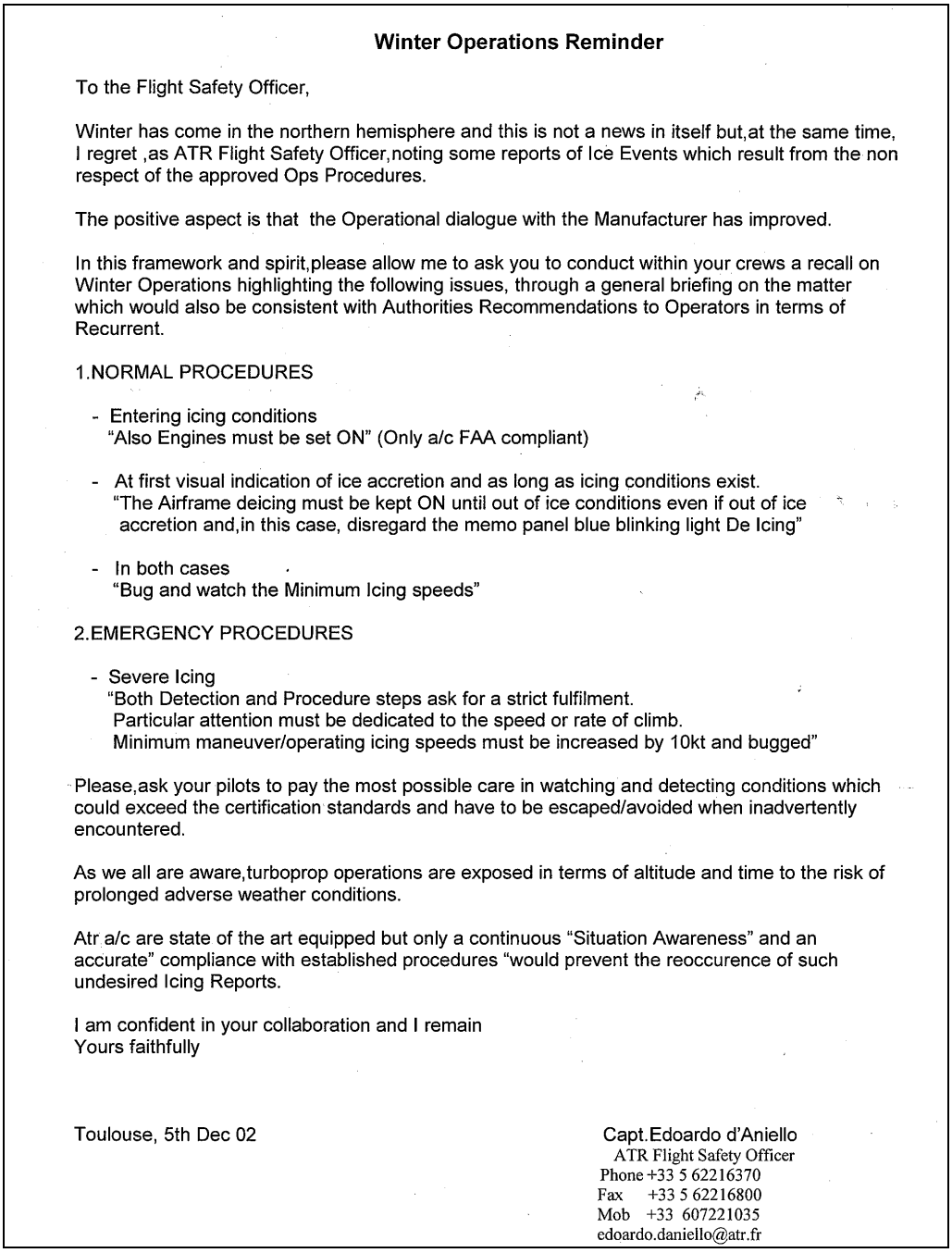
■ **If the aircraft is not clear of ice :**
–Maintain flaps 15 for approach and landing with "reduced flaps APP/LDG icing speed" + 5 kt.
–Multiply landing distance flaps 30 by 1.91

R

–Report these weather conditions to Air Traffic Control.

1.18.5 Winter Operations Reminder of ATR aircraft

According to ATR Flight Safety Officer, he issued a Winter Operations Reminder via fax on December 5, 2002, to every airline that uses ATR aircraft. See Figure 1.18-X.



Winter Operations Reminder

To the Flight Safety Officer,

Winter has come in the northern hemisphere and this is not a news in itself but,at the same time, I regret ,as ATR Flight Safety Officer,noting some reports of Ice Events which result from the non respect of the approved Ops Procedures.

The positive aspect is that the Operational dialogue with the Manufacturer has improved.

In this framework and spirit,please allow me to ask you to conduct within your crews a recall on Winter Operations highlighting the following issues, through a general briefing on the matter which would also be consistent with Authorities Recommendations to Operators in terms of Recurrent.

1.NORMAL PROCEDURES

- Entering icing conditions
  "Also Engines must be set ON" (Only a/c FAA compliant)

- At first visual indication of ice accretion and as long as icing conditions exist.
  "The Airframe deicing must be kept ON until out of ice conditions even if out of ice accretion and,in this case, disregard the memo panel blue blinking light De Icing"

- In both cases
  "Bug and watch the Minimum Icing speeds"

2.EMERGENCY PROCEDURES

- Severe Icing
  "Both Detection and Procedure steps ask for a strict fulfilment.
  Particular attention must be dedicated to the speed or rate of climb.
  Minimum maneuver/operating icing speeds must be increased by 10kt and bugged"

Please,ask your pilots to pay the most possible care in watching and detecting conditions which could exceed the certification standards and have to be escaped/avoided when inadvertently encountered.

As we all are aware,turboprop operations are exposed in terms of altitude and time to the risk of prolonged adverse weather conditions.

Atr a/c are state of the art equipped but only a continuous "Situation Awareness" and an accurate" compliance with established procedures "would prevent the reoccurence of such undesired Icing Reports.

I am confident in your collaboration and I remain
Yours faithfully

Toulouse, 5th Dec 02

Capt.Edoardo d'Aniello
ATR Flight Safety Officer
Phone +33 5 62216370
Fax +33 5 62216800
Mob +33 607221035
edoardo.daniello@atr.fr

Figure 1.18-9 Winter Operations Reminder

1.18.6 ATR72 Freighter Operating Procedures

The following relevant procedures are quoted from TNA ATR-72 Freighter Operating Procedures:

- Loading Instruction/Report: Prepared by the head of on-shift team of Freight Section or by senior officer who is responsible for calculating the weights of cargo and arranging the bays for the cargo.
- Supervisor at the side of aircraft: Undertaken by export staff member of Freight Section who is responsible for preparing documents, unloading cargo out of bays, and supervising loading operation.
- Outlines of operation at apron: The front compartment consists of bay 11, 12, and 13, and the rear compartment bay 21,22,and 23. The payload of each bay shall not exceed 1,166kg. The total payload of front/rear compartment shall not exceed 3,500kg. When carrying cylindrical fabrics, their direction shall be parallel to the fuselage. They shall not be placed crabwise to prevent from rolling when aircraft takeoff or landing as it may cause an uneven balance and hence endanger the flight safety.

IV、 Attachments

2-1 GE791 flight crew briefing information

2-2 GE791 Operational Flight Plan

2-3 The photocopy of GE791 Flight Plan

2-4 JEPPESEN Navigation Chart (Taiwan and Hong Kong area only) which used by TNA flight crew

2-5 The photocopy of Meteorological Conditions received by GE791 flight crew

2-6 GE791 Loading Instruction/Report

2-7 GE791 Cargo Manifest

2-8 The photocopy of CERTIFICATE OF REGISTRATION OF CIVIL AIRCRAFT NATIONALITY for B22708

2-9 The photocopy of CERTIFICATE OF AIRWORTHINESS for B22708

2-10 The photocopy of Aircraft Radio Station License for B22708

2-11 Personal information and training programs and records of CM-1

2-12 Personal information and training programs and records of CM-2

2-13 Recurrent training programs of TNA pilots in 2002

2-14 Recurrent training records of TNA pilots in 2002

2-15 TNA flight crew flight safety recurrent training programs in recent five years

2-16 TNA dispatcher recurrent training programs and records in 2002

2-17 Training programs and records of the operator who in charge of preparing Load and Trim sheet for GE791.

2-18 CAA inspection records on TNA

2-19 NA pilot schedule issued between October and December 2002

2-20 Records of TNA's Flight Operations Circular, ATR Fleet Circular, and ATR Real-Time Info throughout 2002

2-21 ATR72-200 Cockpit Checklist for B22078

2-22 ATR72 Quick Reference Hand Book

2-23 ATR72 Flight Crew Operating Manual Vol. I

2-24 ATR72 Flight Crew Operating Manual Vol. II

2-25 ATR72 Flight Crew Operating Manual Vol. III

2-26 ATR72 Airplane Flight Manual

2-27 ATR72 Minimum Equipment Requirement Manual and Exterior Difference Manual

2-28 TNA Flight Operations Manual

2-29 Operations Manual of TNA Flight Operations Department

2-30 TNA Flight Training Management Manual

2-31 Operations Manual of TNA Security & Safety Office

2-32 Operations Manual of TNA System Operation Center

2-33 Operational Procedure of TNA ATR72 Freighter

2-34 Design Modification Certification (used for conversion of B22708 into Freighter)

2-35 Operations records of dispatching and loading of a certain ground services company for GE791

2-36 The operation bulletin of a certain ground services company for TNA ATR72 Freighter

2-37 A certain ground services company's training records of loading/unloading workers

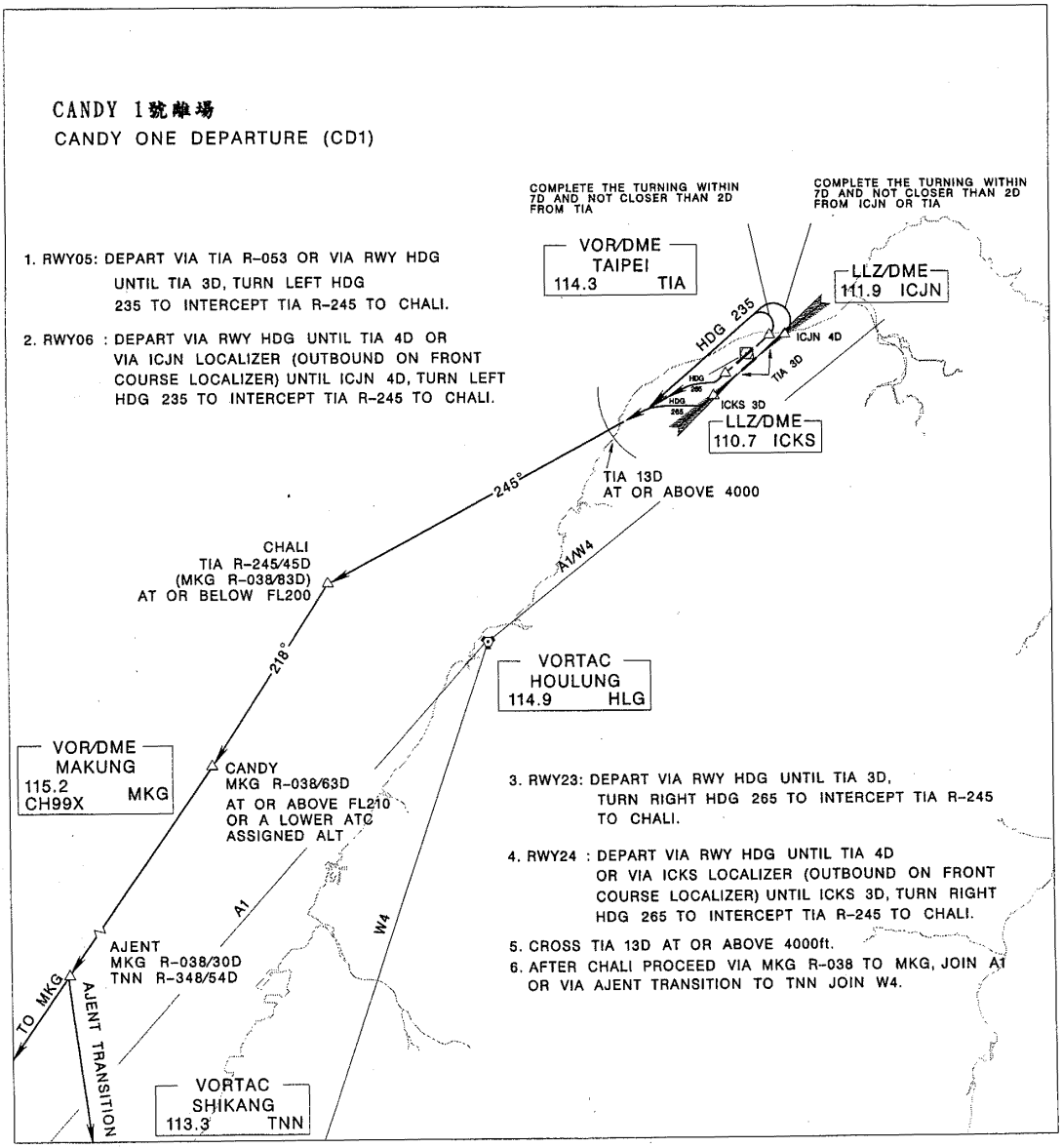
2-38 Twenty-nine copies of interview records

2-39 "The List of Applicable Publications" (ATR72-200 AFM / RO15 / Issue: OCT-02), TNA received from ATR

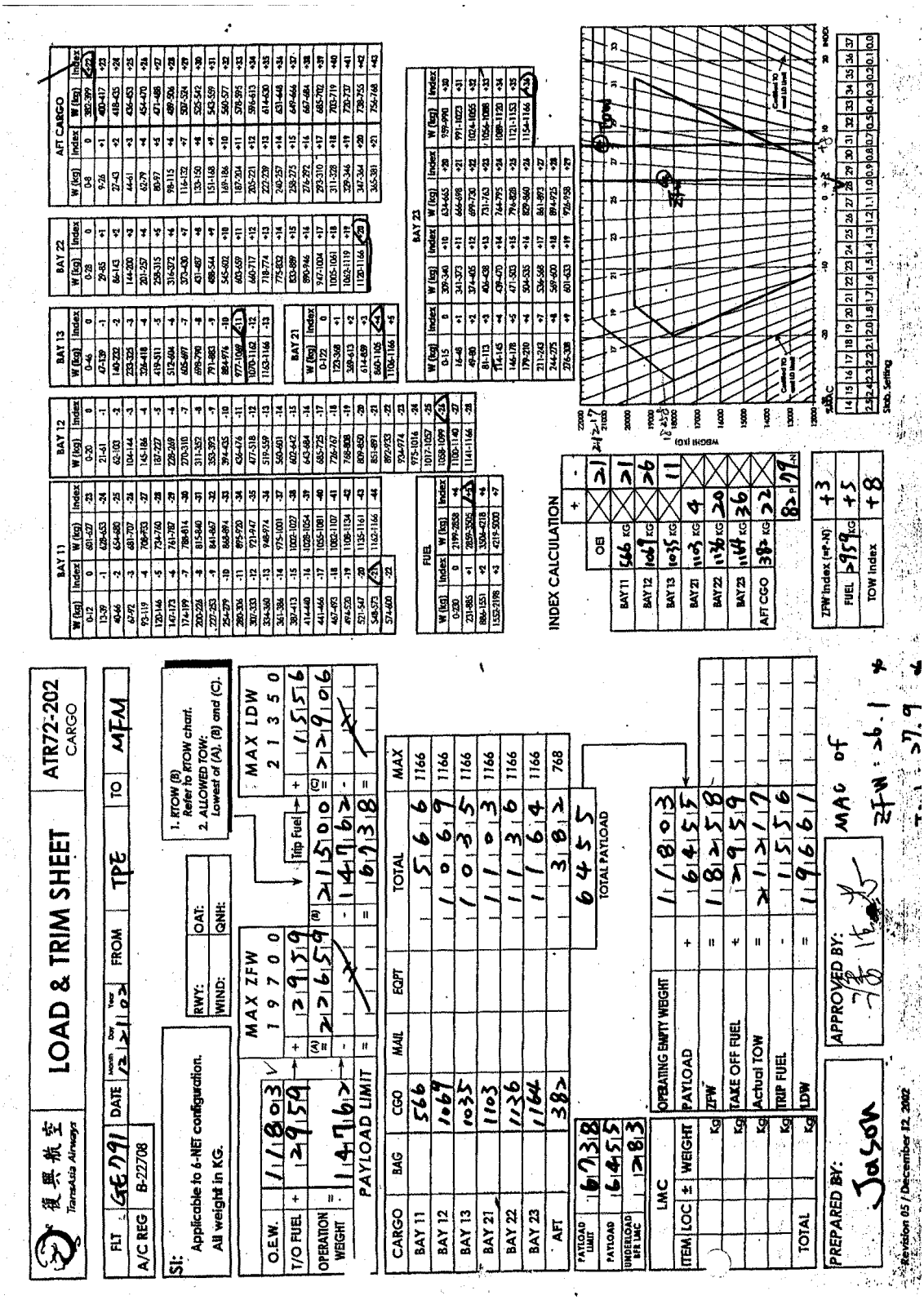
2-40 Airworthiness Directive, DGAC 2001-045-054(B) / FAA AD 99-19-10 / CAA AD 90-ATR-153

V、 Appendix

2-1 CANDY ONE Departure, CKS International Airport



2-2 The Load and Trim Sheet of GE 791



Intentionally Blank