



PAKISTAN CIVIL AVIATION AUTHORITY
(SAFETY & INVESTIGATION BOARD)



SEVERE WEATHER ENCOUNTER TO M/S. PIAC
FLIGHT PK-770, BOEING-777-200ER, REG. # AP-BHX
ON 2ND JULY 2008
AT
MILAN – ITALY

FINAL REPORT

INVESTIGATIONS INTO SERIOUS INCIDENT TO B777-240ER AP-BHX DURING DESCENT TO MALPENSA AIRPORT IN ITALY ON 2ND JULY 2008

Authority: Director General Civil Aviation Authority Memorandum
No.HQCAA/1901/324/SIB dated 16 July 2008.

Synopsis

On 2nd July, 2008, a Pakistan International Airlines B777-240ER aircraft, registration marks AP-BHX, while passing through 18,000' feet during descent at Milan Malpensa airport (Italy) encountered severe weather conditions, causing extensive damage to aircraft structure. The aircraft remained at Milan airport for 51 days for necessary repairs by Boeing costing more than seven million US \$ to national exchequer. Though the incident had occurred in Italian airspace and as per the standards of ICAO Annexure 13, the investigation, if any was to be conducted by Italian authorities, yet DG CAA; taking into consideration the operational aspects of the incident, ordered an inquiry to determine weaknesses which might have contributed to the serious incident (**Appendix 'A'**). The investigations by PCAA (SIB) as state of registry and operator, was based on the statements and interviews of the aircrew. The evidence indicated that aircrew were aware of the bad en-route weather, and made a request with air traffic control of Italy for a diversion to avoid the weather but the same was not given instantly by air traffic controller of Milan due traffic; hence they could not avoid the weather resulting into serious damage to aircraft. SIB produced an "Interim Report" (**Appendix 'A-1'**) and notified Boeing company and Italian Civil Aviation Authorities thereby requesting for an access to the information available at air traffic control services of Italy (Malpensa). The initial response from Italy was lukewarm, however after the visit of the Pakistani investigation team, the authorities realised their obligations as signatory to Chicago Convention and instituted an investigation as state of occurrence, through Agenzia Nazionale per la Sicurezza del Volvo (ANSV).(**Appendix 'B'**). The Investigator-In-Charge, designate Mr. Pannetta in consultation with the Safety & Investigation Board of Pakistan CAA produced the final report on 28th January 2009, as per ICAO Annexure - 13. Same information has been reported in the ECCAIRS data base. PCAA acknowledges the efforts made by ANSV – Italy during the investigation.

1. Factual Information

- | | | |
|-----------------------------|---|---------------------|
| 1.1. Aircraft Type & Reg. # | : | B777-240 ER, AP-BHX |
| 1.2. No. & Type of Engine | : | GE-90 |

- 1.3. **Year of Manufacturing** : Feb 2007
- 1.4. **Date & Time** : 2nd July 2008 (1658 to 1700 UTC)
- See occurrence report under MOR system and Pilot's Debrief at **Appendix 'C'** for details
- 1.5. **Location** : Under Milan approach radar control approximately 45 – 50 track miles SW on published arrival procedure descending from 18,000' to land at Milan (Italy) Airport

1.6. **Type of Flight:** Commercial Air Transport (Pax).

1.7. **Injuries:** None.

1.8. **Weather:** The weather reports for the entire Italian airspace in general and of the route to Malpensa in particular are attached as **Appendix 'D'**. The reports contain complete satellite information on weather after every half an hour from 15.00 hrs to 1730 hrs. The satellite pictures show clouds over Malpensa. It was also learnt from the interviews of a number of personnel, including aircrew of Easy Jet, a UK based operator which operate a number of flights to Malpensa. It was the opinion of the Easy Jet aircrew that weather at Malpensa during July is always difficult and full of turbulence and one has to be very careful while coming down at Malpensa.

1.9. **Nature of Damage:**

1.9.1. The aircrew and passengers observed and felt the phenomena at a larger scale. One of the passengers was so terrified that he had to be given medical attention for which the aircrew requested positioning of an ambulance. The evidence was recorded with tower communication with aircraft. The initial survey after landing revealed the following damages:

- (a) Broken Radome.
- (b) Captain & First Officer windshield broken
- (c) Right & Left inlet pack damage (dents)
- (d) Left & right leading edge of wing area between engine and fuselage damage (honeycomb panels with dents).
- (e) Two panels found damage with hole (1 inch).

1.9.2 The detailed survey revealed extensive damage to a number of panels (See **Appendix 'E-1' & 'E-2'**) for details of damage and photographic evidence of damage. The cost of repair and parking alone was more than 7 million US \$. (See **Appendix 'E-3'**). The following areas were found with extensive damage:

- (a) LH & RH wing inboard Lower Panel assemblies, (18 such assemblies were damaged)
- (b) Fuselage Fairing panels
- (c) Ram Air Turbine Inlet

- (d) Horizontal Stabilizer centre Leading Edge
- (e) Multiple dents and depressions at various places

1.10 **CVR:** Capable of recording last two hours communication at two channels. However the aircrew did not preserve the CVR after the event. The CVR by design keeps on running when the main power is on for the aircraft systems; as the aircrew did not switch off power after landing due to passengers on board and other uncertainties; the CVR tape kept on running and as a result erased the vital communication related to the event.

1.11 **DFDR :** DFDR data was downloaded and analysed. It confirms that aircraft entered into turbulence / weather for 12 & 22 seconds in two different stages during weather encounter. The variations in pressure altitude, wind speed, lateral and vertical accelerations and vertical speeds indicate the effects of weather on the aircraft data.(See **Appendix 'F'** for DFDR data)

1.12 **Aircrew Information:**

1.12.1 **Captain (PF)** : Male, Pakistan nationality

- (a) Age : 54
- (b) Type of License Held : ATPL
- (c) Type Current Rating : P1 – B777
- (d) Grand Total Flying Hours : 21,645 hrs
- (e) Total in command : 13,900 hrs
- (f) Total as Capt. On type : 803 hrs
- (g) Medical Date : 10-01-2008 (Class -1)
- (h) Where Trained : CAE Emirates, Dubai
- (i) Last Simulator Check : 19-01-2008 – Dubai

1.12.2 **First Officer (PNF)** : Male, Pakistan nationality

- (a) Age : 48
- (b) Type of License Held & No. : ATPL
- (c) Type Current Rating : P2 – B777
- (d) Grand Total Flying Hours : 8,785 hrs
- (e) Total in command : Nil
- (f) Medical Date : 21-01-2008 (Class-1)
- (g) Where Trained : Boeing – Seattle
- (h) Last Simulator Check : 12-02-2008 – Dubai

1.12.3 **Additional Captain (Augmented Crew):** Male, Pakistan nationality

(Non operating status occupying Jump seat)

- (a) Age : 58

(b)	Type of License Held & No.	:	ATPL
(c)	Type Current Rating	:	P1 – B-777
(d)	Grand Total Flying Hours	:	16,527 hrs
(e)	Total in Command	:	11,071 hrs
(f)	Total on B-777	:	2763 hrs
(g)	Medical Date	:	20-05-2008 (Class-I)
(h)	Where Trained	:	Boeing – Seattle
(i)	Last Simulator Check	:	23-05-2008 – Dubai

1.13 Radio Communication

1.13.1 The Italian investigation authorities provided the transcript of radio communication between aircrew and two area control centres and finally with Malpensa tower and ground. The details are attached as **Appendix 'G-1' to 'G-4'**. Following are the relevant portions from radio communication between PK-770 and three components of Air Traffic Control Services of Italia.:

(a) PK-770 communication with ACC SWN at frequency 125.275

i.	1651.34	PIA770	And Milano PIA770 we need to turn left 5 degrees all right?
ii.	1651.38	LIMM	No Problem 770
iii.	1651.42	---	Thank you
iv.	1654.32	---	Due to weather...can we turn right xxx possible?
v.	1654.36	LIMM	Calling Milano?
vi.	1654.37	PIA770	PIA770 we need to turn to avoid weather sir.
vii.	1654.40	LIMM	Ok ok turn right no problem is better for me turn right
viii.	1654.44	PIA770	PIA770 rgoer
ix.	1656.42	PIA770	And Milano PIA770 is it possible we could turn left... direct to ASTIG all right sir?
x.	1656.49	LIMM	Eh...PIA770 unable at the moment continue on heading descend level 180
xi.	1656.54	PIA770	On heading 180 PIA770
xii.	1657.39	LIMM	PIA770 clear to ASTIG point
xiii.	1657.43	PIA770	Unable to go direct ASTIG due to weather PIA770
xiv.	1657.47	LIMM	Ok sir so you prefer left turn to VERCE confirm?
xv.	1657.51	PIA770	Affirm 770
xvi.	1657.52	LIMM	Ok clear to VERCE sir
xvii.			

(b) PK-770 communication with ACC SWN at frequency 125.625

i.	1700.44	LIMM	PIA770 Milano able to turn right heading 085?
ii.	1700.50	PIA770	Ah... able sir we are able xxx 050 PIA770
iii.	1700.55	LIMM	PIA770 roger heading 050 is as ... approved expect right turn when able due to sequence
iv.	1701.03	PIA770	Right 050 PIA770 say again the heading please
v.	1701.07	LIMM	PIA770 if able heading 050 I call you back in about 7

			miles for right turn due to sequence on heading 090 sir pay attention we have a lot traffic along your route.
vi.	1701.19	----	Ah heading 090 sir we are just going to very... to very very severe radar
vii.	1701.24	LIMM	Ah PIA770 roger Ah are you able to fly heading 065?
viii.	1701.30	PIA770	Affirm 70...PIA770
ix.	1701.33	LIMM	PIA770 right heading 065 descend FL 140
x.	1701.40	PIA770	Right 065 and descend 140 PIA770
xi.	1702.05	PIA770	Ah...Milano PIA770
xii.	1702.07	LIMM	PIA770 go ahead
xiii.	1702.10	----	Due xxx we have broken windshield so due to the hailstorm.
xiv.	1702.16	LIMM	PIA770 roger no problem now loud and clear speed 230 Knots descend FL 130
xv.			

(c) **PK-770 communication with Malpensa Tower**

i.	17.09.28	PIA770	Good evening Tower, this is Pakistan 770 on ILS 35L.
ii.	32	TWR	Buona sera Pakistan 770, QNH 1011, becoming number 1.
iii.	46	TWR	Pakistan 770, left "DA", ground 121.9. Beautiful landing, sir!
iv.	17.13.58	PIA770	This is Pakistan 770, "DA".
v.	17.14.03	TWR	Pakistan 770 good evening. Taxi left on "W", right on "R" stand 503.
vi.	17.16.08	TWR	Pakistan 770 is coming the ambulance on the stand.
vii.	50	PIA 770	We'll do sir. Thank you 770.

1.14 **Radar Picture of AP BHX:** Italian ANSV provided the complete flight path of the AP-BHX since it entered FARAK and was handed over to control tower at Malpensa. The radar pictures attached as **Appendix 'H'** give aircraft speed, height, and position based on inertial coordinates for every six seconds.

2. Investigation and Analysis

2.1 The initial aircrew interviews revealed that they were aware of weather along the route and in order to avoid bad weather, the Captain requested radar controller for deviation from the given flight path of standard Instrument arrival procedure for Milan. The Captain further stated that he requested for a deviation to avoid the weather but the same was not granted instantly; however the same deviation was approved after some time. The Captain's understanding is that the late deviation resulted in entering weather which caused major damage to aircraft structure. In aviation when captain is in command of a flight then the safety of passengers is the responsibility of the Captain of the aircraft and he has at his disposal a number of alternatives and standby systems in emergencies and air traffic services are in the advisory role. However, it was considered essential to collect information on weather, radar records of the flight and radio communication between aircraft and air traffic controllers to have the complete understanding of the event for making safety recommendations. It was quite obvious from the initial data on the occurrence that neither the incident was a new in aviation operations and nor the causes were different from previous events of similar nature in aviation history. In such cases where event is well defined and causes, too, are well known and established in earlier safety investigations; the attention of the investigators has to be focused on organisational culture and attitude and behaviour of individuals in emergency, the aircrew history being the most relevant.

2.2 Air crew history, their past performance and organisation culture - Analysis:

2.2.1 Air crew training records from their induction in PIA till date were scrutinised for their performance evaluation. These are attached as **Appendix 'J'** and their respective performance analysis is attached as **Appendix 'K'**. The training records for the captain indicate that the individual has weaknesses since his induction in PIA. "Situational Awareness" has been a very important attribute for aircrew and responsible for majority of incidents and accidents in aviation, and the same has been identified as a weak area for Captain Ahsan Rehman (PF) during different checks in last 15 years. For instance:

- a. His performance has been rated as "barely satisfactory with minimum standard", during Initial Simulator Test on B-777 on 24 July 2007. He was again advised to improve his situational awareness on 19th January 2008. It is also interesting to note that the Captain Ahsan Rehman was also advised to improve his "**Situational awareness**" during a simulator checks for A 310 on 10 June 2003. In an earlier evaluation for supervisory appointment, the remarks by different Chief pilots included
- b. Technical Knowledge Unsatisfactory Knowledge of route manual and procedures below standard.

- c. In 1998 during transition training assessment the comments of the evaluator are full of observations on his emergency handling, reactions and overall performance.

2.2.2 Hence the performance and emergency handling of Captain Ahsan Rehman (PF) in this incident, is not unexpected, it is exactly an exhibition of his weaknesses observed and recorded by supervisors during last 16 years. Why a corrective action was not taken in the past is attributed to poor safety culture at organisational level. ICAO has identified absence of “positive safety culture” as a root cause of such events. Refer ICAO SMS Manual Document 9859.

2.2.3 Pilots are end users in any organisation. Nearly 80% of occurrences in aviation industry are attributed to aircrew’s performances. Organisational culture influences individual and group behaviour and results in a peculiar behaviour and reflects hidden / underlying issues of organisation. Hence the improvement can only be made through inculcation of a positive or a just culture in aviation organisation.

2.2.4 The records of the first officer also indicate a number of weaknesses. Two samples can reflect upon the professional competency of the first officer

- a. On 3rd Feb 2007, the evaluator remarked “Khalid’s FMC work is below minimum expected standard needs to review/revise FMC exercises again before a check.
- b. On 29 September 2006, the evaluator remarked “F/O Khalid came without the required documents. This kind of an attitude reflects poorly towards his commitment for the simulator training and check”.

2.2.5 The senior captain who was occupying the jump seat during this occurrence has a good professional record. However why he could not intervene to save the event needs discussion on the operators procedures on “Duties and Responsibilities of Aircrew” (**Appendix ‘L’**). The pairing of a Captain with known weaknesses of situational awareness and a first officer with casual attitude also indicates weakness at the operations planning.

2.3 **Radio Communication Analysis:**

2.3.1 Following is a detailed analysis of the radio communications between aircraft and Air Traffic Control Services in Italy:

- (a) With the aircraft descending to FL 200, PIA 770 requested to turn right due to weather and it was granted.

- (b) At 16.56.42 UTC PIA 770 asked to turn left direct to ASTIG¹ and after 57 seconds ATC cleared it to ASTIG;
- (c) Four seconds later, however, PIA 770 replied that they were unable to go to ASTIG due to weather.
- (d) Most probably the aircrew requested to go direct to ASTIG in order to shorten the route, but they did not take into consideration the weather along the route itself.
- (e) Later ATC proposed to PIA 770 to turn left and go direct to VERCE² and the aircrew accepted. ATC requested to change frequency from 125.725 to 125.625 MHz (different sector – ASW of Milano ACC).
- (f) According to DFDR data analysis, it was at this stage that the aircraft entered into bad weather with an indicated airspeed of 280-290 Kts, pressure altitude of 18.000 ft and vertical acceleration rapidly changing;
- (g) Simultaneously, radio communications also resulted to be very disturbed by a background noise similar to hail pounding against aircraft structure. ATC called three times the aircraft with no reply for about 30 seconds. After positive reply from the aircraft, ATC communicated positive radar contact, cleared vectoring 35L and descend to FL 160. The heading of PIA 770 was about 350°-355°. Later on radio communications were not disturbed anymore by the background noise.
- (h) ATC requests to PIA 770 if they were able to turn right on heading 085 and aircrew replied that they were able to maintain 050.
- (i) ATC approved a heading request of 050 and instructed also the aircrew to “expect right turn when able due to sequence”. ATC continued to inform PIA 770 that the right turn to 090 was going to be given because of “sequence” and warned the aircrew to pay attention since the presence of a lot of traffic along the route.
- (j) The aircrew informed ATC that with heading 090 they might be going into “very very severe weather”. ATC then asked if they were able to maintain heading 065 and this was accepted.
- (k) The aircraft most probably entered again into bad weather as the aircrew reported after one minute to have broken windshield due to hailstorm. Also DFDR data shows rapid vertical acceleration changes. **(Appendix ‘F’)**

2.3.2 The above conversation between PK 770 and ATC of radar/approach/tower at Milan does not support the contention of the Captain of PK 770 that the aircraft was not cleared for a diversion from the track to avoid weather. Rather, despite of heavy

traffic, PK 770 was almost flying on the desired headings as requested by the aircrew. The remaining flight was uneventful, the aircrew never declared emergency and the aircraft landed on runway 35L at 17.12 UTC, without any other problems. Once on ground the aircrew requested an ambulance and a doctor because one of the "personnel on board had a heart-attack".

2.4 The Airborn Boeing Radar Capability

- 2.4.1 The B777 is equipped with a high tech - airborne weather radar. This radar has the capability to detect and show the presence of precipitation, wet hail and adequate warnings of wind shear / turbulence. According to Boeing statement, the weather radar can reflect large wet hail and will display this type of hail as red on the display. **However, if the hail is dry and/or above the freezing level, the weather radar will either not detect the precipitation or the radar will show less reflect on the display. The weather radar cannot detect frozen particles as they are poor reflectors of radar energy.** See **Appendix 'M'** for Boeing's response to PIA's query regarding 777 weather radar performances. It does not imply that radar is of no use; it locates and provides adequate information on weather, well in advance, and the aircrew can take preventive measures. It is not the discretion of aircrew whether or not enters the weather system after assessment of severity. If there is a system it must be avoided in the interest of safety. There have been instances where even if the deviation from the planned route is not granted by the ATC, the crew has either deviated or turned back.
- 2.4.2 **Conclusion:** Analysis of the radio communications between the aircraft and the air traffic controllers involved showed that all clearances on the heading were given to the aircrew in order to avoid any conflict with other traffic and to respect the right sequence for the approach. Moreover, all the time that a deviation was requested by the aircrew it was granted with minimal delay which is expected in a high traffic zone.
- 2.4.3 The entry of aircraft into serious weather is an indication of poor airmanship displayed by the aircrew members present in the cockpit. If concepts and utility of training through "Cockpit Resource Management" is taken into account, it appears that this set of aircrew has not learnt any lesson from CRM.

3. Findings

- 3.1. The aircraft was airworthy and the radar and other navigational aids were serviceable.
- 3.2. There was augmented aircrew on board, and on sector from Paris to Milano, the senior Captain Gabol was occupying the rear seat in the cockpit, while Captain Ahsan was on left seat and F/O Khalid was on right seat.
- 3.3. The aircrew were aware of the weather en-route, which was cloudy and had CBs.
- 3.4. The aircraft was vectored for landing at Milan.
- 3.5. The aircraft entered weather, while approaching for Milan.
- 3.6. The aircrew, although aware of the en-route weather, could not avoid it due to delayed reaction.
- 3.7. The aircraft sustained severe damages.
- 3.8. The actual cost of occurrence is difficult to calculate, but indirect costs such as non utilisation of aircraft, ground crew and human resource will add up a significant figure to total cost of occurrence.
- 3.9. The incident is well known and the causes are determined in earlier such occurrences.

Cause of Occurrence

The aircrew failed to avoid known weather conditions and entered the weather thereby causing damage to aircraft structure.

4. Safety Recommendations

- 4.1 Use of weather radar, weather deviation techniques in high density terminal areas and exercising of authority of captain should be included in training programme and simulator exercises. Modern trainings like Computer generated weather avoidance modules can be used which are available with different vendors.
- 4.2 Senior Management of AOC holders in consultation with Flight Standards Directorate of PCAA should carry out a study through aircrew training records in identifying weak cases and process them to Training programme like CRM. The training programme should focus on individual weakness for corrective measure. This refers to recommendation No. 6.4 of aircraft accident investigation report into serious incident to M/s. PIAC 21 Nov 2006 AP-

BDZ A-310 and recommendation No. 7.7 from F-27 10 Jul 2006 AP-BAL investigations are reproduced below:

"PIA Flight Safety and Operations to carry out a study to identify aircrew members who are likely to perform poorly during emergency handling and take specific measures to ensure their operational fitness".

"PIA should institutionalize their system to study the human behaviour of aircrew with a view to pre-empt their behaviour under emergencies".

4.3 Operator should have a clear reporting procedure for incident / accident to relevant investigation agency in Pakistan and out side the country.

4.4 Operators should, through emergency procedures, ensure that aircrew, in case of an incident / serious incident must take action to preserve CVR and FDR evidence.

4.5 The pairing by the operations should take into account the professional competency, age and behaviour under stress of the Captain and First officer to ensure CRM in the emergency. New modules of decision making and human factor to be intruduce in CRM syllabus.

4.6 Effective organistaional safety culture and oversight mechanism, in line with ICAO SMS Document 9859, be complemented to promote safety standards within the organisation.













