الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

United Arab Emirates

Air Accident Investigation Sector

Serious Incident

- Final Report -

AAIS Case Nº AIFN/0012/2017

AIRPROX
(Loss of Separation)

Operators:	Etihad Flight College (Etihad Aviation Training), for both aircraft
Make and Model:	1. Diamond, DA42NG 2. Embraer, PHENOM 100
Nationality and Registration:	The United Arab Emirates 1. A6-FTX 2. A6-EFA
Place of Occurrence:	Three nautical miles north Al Ain International Airport
State of Occurrence :	The United Arab Emirates
Date of Occurrence:	16 October 2017

Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

Occurrence Brief

AAIS Report Nº	:	AIFN/0012/2017
Operator	:	Etihad Aviation Training, for both aircraft
Aircraft Type and Model	:	1. Diamond, DA42NG (DA42)
		2. Embraer, PHENOM 100 (E50P)
Registration Mark	:	1. A6-FTX
		2. A6-EFA
Manufacturer Serial Number	:	DA42 S/N: 42.363
		E50P S/N:50000373
Number and Type of Engines:		DA42 Twin Engines: Austro Engine AE300
		E50P 2X Pratt & Whitney PW617F1-E
Date and Time (UTC)	:	16 October 2017, 0250
Place	:	Three nautical miles north Al Ain International Airport
Persons on-board	:	DA42 Two (one cadet pilot, one instructor pilot)
		E50P Three (two cadet pilots, one instructor pilot)
Injuries	:	None

Investigation Objective

This Investigation was conducted by the Air Accident Investigation Sector (AAIS) pursuant to the United Arab Emirates (UAE) *Federal Act No 20 of 1991*, promulgating the *Civil Aviation Law, Chapter VI – Aircraft Accidents*, Article 48. It is compliance with the UAE *Civil Aviation Regulations* (*CARs), Part VI, Chapter 3*, in conformity with *Annex 13 to the Convention on International Civil Aviation*, and in adherence to the *Air Accidents and Incidents Investigation Manual*.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

The information contained in this Final Report is derived from the factual information gathered during the investigation of the occurrence.

All AAIS reports are publicly available from

http://www.gcaa.gov.ae/en/epublication/pages/investigationreport.aspx

Investigation Process

The occurrence was notified to the General Civil Aviation Authority (GCAA) by filing an incident report in the Reporting of Safety Incident (ROSI) system, by the Operator on 17 of October 2017 (next day to the occurrence).

Following the review and initial investigation phase by the Air Accident Investigation Sector (AAIS) Duty Investigator (DI), the occurrence was classified as a “Serious Incident”.

In accordance with the Standards of *Annex 13 to the Convention on International Civil Aviation*, an Investigation Team was formed by the AAIS as the United Arab Emirates is the State of Occurrence. The International Civil Aviation Organization (ICAO) and the States of the two aircraft Design and Manufacture (Austria and Brazil) were notified in line with the ICAO *Annex 13* obligations.

The Austria Federal Office for Transport, Civil Aviation Safety Investigation Authority, and the Brazil Cetro de Investigacao e Prevencao de Acidentes Aeronauticos-CENIPA, being the States of Manufactures, assigned Accredited Representatives to the Investigation.

Notes:

1. Whenever the following words are mentioned in this Report with first letter Capitalized, they shall mean the following:

   (Incident) – this investigated serious incident referred to on the title page of this report

   (Investigation) –the investigation into the circumstances of this serious incident

   (Report) – this serious incident Final Report

2. Unless otherwise mentioned, all times in this Report are 24-hour clock in Coordinated Universal Time (UTC), (UAE Local Time minus 4 hours).
3. Photos and figures used in this Report are taken from different sources and are adjusted from the original for the sole purpose to improve the clarity of the Report. Modifications to images used in this Report are limited to cropping, magnification, file compression, or enhancement of color, brightness, contrast, or addition of text boxes, arrows or lines.

Abbreviations

AAIS	The Air Accident Investigation Sector
ACAS	Airborne collision avoidance system
ADC	Aerodrome controller
APPE	Approach East Radar Control
ANA	Air Navigation and Aerodromes
AIRPROX	Aircraft proximity
ANS	Air navigation service
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATCUs	Air Traffic control units
ATM	Air Traffic management
ATPL	Air Transport Pilot License
ATO	Aviation Training Organization
ATSOM	*Air* Traffic *Services Operations Manual*
CAAP	*Civil Aviation Advisory Publication*
CAR	*Civil Aviation Regulation* of the United Arab Emirates
CAR-OPS	*Civil Aviation Regulation* of the United Arab Emirates – *Flight Operation*
CAVOK	Cloud and Visibility Okay
C of A	Certificate of airworthiness
CoC	Certificate of competence
COM	Communication
CRM	Crew resource management
CVR	Cockpit voice recorder
CPL	Commercial pilot license
DA42NG	Diamond DA42 Twin Star Aircraft
DI	Duty Investigator
Doc	Document
EAT	Etihad Aviation Training
E50P	Embraer EMB-500 Phenom 100 Aircraft
FDR	Flight Data Recorder
ft	feet
GCAA	The General Civil Aviation Authority of the United Arab Emirates
hrs	hours
ICAO	International Civil Aviation Organization
IIC	Investigator-in-charge
ILS	Instrument landing system
kg	kilogram
Km	Kilometers
kts	knots
LATSI	*Local Air Traffic Services Instructions*
LoA	Letter of agreement
LT	Local time
m	meters
MOPS	Minimum operational performance standards
MSN	Manufacturer serial number
No.	Number
NPA	Notice of proposed amendment
OJT	On-the job training
OMAL	Al Ain International Airport
QNH	Barometric pressure adjusted to sea level
ORCAM	Originating region code assignment method

PFD	Primary flight display
RA	Resolution advisory
RH	Right hand
SA	Situation (or situational) awareness
SOP	Standard operating procedures
SSR	Secondary surveillance radar
STCA	Short term conflict alert
TCAS TA	Traffic collision avoidance system - traffic advisory
TCAS RA	Traffic collision avoidance system - resolution advisory
UAE	The United Arab Emirates
UTC	Co-ordinated universal time
VHF	Very high frequency
VOR	Very high frequency omnidirectional range (navigation system)

Synopsis

On 16 of October 2017, three nautical miles (nm) north of Al Ain International Airport, two training aircraft registered and operated by Etihad Flight Training College, were under the control of Approach East Radar Control (APPE), in training missions as per published approach procedures. One of the aircraft (DA42NG), and as part of the training, executed a VOR Z missed approach after receiving clearance from the APPE controller. During the climb, the DA42NG received an instruction from the APPE controller to stop the climb due to company traffic holding.

The training instructor at a lower altitude disengaged the autopilot and commenced a descent to the newly assigned altitude. Simultaneously, a traffic advisory (TA) sounded and an annunciation appeared on the primary flight display (PFD). There was also a TA alert on the other aircraft PFD, and both aircraft came within close proximity to each other.

The Air Accident Investigation Sector (AAIS) determined that the cause of this Incident was the loss of minimum separation (AIRPROX) between the two aircraft, which were following instructions provided by ATC.

The safety recommendations contained in this Report are addressed to the GAL Air Navigation Services and the General Civil Aviation Authority (GCAA) of the United Arab Emirates.

Table of Contents

List of Tables

List of Figures

1. Factual Information

1.1 History of the Flight

On 16 October 2017, Etihad Aviation Training (EAT) scheduled two aircraft with cadet pilots and instructor pilots to conduct training missions. The instructors briefed the cadets on the respective training mission plans.

The first aircraft was a Diamond DA42, flight number EYT405, registration A6-FTX, which departed at approximately 0029 UTC from runway 01, at Al Ain International Airport (OMAL). The DA42 training mission was to conduct instrument landing system (ILS), VOR approaches and missed approaches. Instructor pilot and cadet pilot were on-board.

The other aircraft was an Embraer PHENOM 100 (E50P), registration A6-EFA, operating flight number EYT516. The aircraft departed at approximately 0050 UTC from runway 01, at Al Ain International Airport (OMAL), with training mission to conduct ILS, VOR Z approaches, and missed approaches. Instructor pilot and two cadet pilot (one flying and second observer) were on-board.

Both aircraft were being flown by cadet pilots, the instructor pilots were the pilots monitoring (PM). After takeoff at 0029 UTC, the DA42 was practicing IFR approaches including the published missed approach segments, which necessitated holding overhead Al Ain VOR/DME. At 0239 UTC, during the final missed approach training, and while climbing at 2,500 feet, the pilot monitoring contacted Abu Dhabi Approach East (APPE) controller for the clearance to enter the hold, and the controller (ATCO) provided clearance to climb to 4,000 feet and enter the hold at ALN.

On the E50P, which was also operating on the vicinity of the airport, the cadet pilot was the pilot flying. An additional cadet was at the time also observing the flight. While executing the first training task of the mission the cadet pilot, at 0240 UTC, requested a missed approach after the execution of the approach as per the published procedures, and the APPE ATCO gave clearance and instructed the to descend according to the procedures, and to contact the Aerodrome Controller (ADC) at Al Ain Tower on radio frequency 119.85 MHz.

E50P called the ADC at 06 nautical miles (NM) for a missed approach, and the ADC instructed to report at 3 NM DME runway 01. The E50P reported at 3 NM DME, and the ADC instructed to report going around. The E50P reported going around and the ADC acknowledged and transferred it to APPE.

After executing the missed approach, during climb at 3,700 feet at 0246 UTC, the E50P instructor pilot reported to APPE that they are at 3,200 feet, and climbing to 5,000 feet. The APPE ATCO instructed them to stop the climb at 3,000 feet, as there was company traffic at their 11 o'clock position at 4,000 feet in the hold ahead of them. The E50P instructor pilot announced that they are visual with traffic and he mentioned that he was in control of the aircraft and was executing a decent.

Meanwhile, the APPE ATCO contacted the DA42 and informed the crew that company traffic was passing behind them at 3,500 feet. The DA42 instructor pilot announced that the traffic was in sight and visual. The closest proximity of the two aircraft was less than 0.5 nautical miles (nm) lateral and 300 feet vertical.

The E50P continued to climb straight ahead on the runway heading after passing the DA42 as per the requested radar vectors for the ILS RWY01. During this AIRPROX[1] occurrence, a traffic collision avoidance system (TCAS) traffic advisory (TA) was displayed on

[1] An AIRPROX is a situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised. ICAO *Doc 4444 – PANS-ATM*

the primary flight displays (PFD) of both aircraft. Simultaneously, the short-term conflict alert (STCA) activated on the APPE radar display.

The AIRPROX event occurred approximately 4 nm north of Al Ain International Airport (OMAL). Following the Incident, both aircraft continued on their intended training missions and later landed uneventfully.

Shortly after the occurrence, the APPE ATCO was relieved from his assigned duties in accordance with the ATC unit's procedure and policy following such an event.

1.2 Injuries to Persons

There were no reported injuries because of the Incident.

1.3 Damage to the Aircraft

Neither aircraft sustained any damage.

1.4 Other Damage

There was no damage to property, or to the environment.

1.5 Personnel Information

1.5.1 The DA42 Flight Crew Data

The information of the cadet and instructor pilots of the DA42, at the time of the Incident, are as shown in table 1.

Table 1. DA42 Flight Crew Data

	Cadet pilot	Instructor pilot
Date of birth	9 March 1992	16 February 1980
GCAA License No.	Not issued	ATPL 33635
Class & Validity of medical	Class 1 Valid until 14 July 2018	Class 1 Valid until 25 February 2018
Flying Experience		
Total all flying hours	40.5	5523
Total flying hours on type	40.5	5523
Total last 28 days	6	52.1
Total last 24 hours	0	0
Line and proficiency check	Trainee pilot	Proficiency check: 22 December 2016
English language proficiency	Trainee pilot	Level 6

1.5.2 The E50P Flight Crew Data

The information of the cadet and instructor pilots of the E50P , at the time of the Incident, are as shown in table 2.

Table 2. E50P Flight Crew Data

	Cadet pilot	Instructor pilot
Date of birth	11 May 1991	23 December 1987
GCAA License No.	Not issued	CPL 67737 UAE-TRI-1652 (Issued 22 Jun 2017)
Class & Validity of medical	Class 1 Valid until 25 May 2018	Class 1 Valid until 23 October 2017
Flying Experience		
Total all types	33.4	2230
Total on type	33.4	101.4
Total last 30 days	6.4	18.5

Total last 24 hours	0	0
Line and proficiency check	Trainee pilot	Proficiency check: 14 June 2017
English language proficiency	Trainee pilot	Level 6

1.5.3 The Approach East (APPE) ATC Controller (ATCO)

The APPE ATCO held a valid and current air traffic control license which entitled him to exercise the privileges of an Approach Control Surveillance (APS) Rating with operational positions: ALN Lima/ALN Mike /ALN PLN.

The day of the Incident was the ATCO's second consecutive day of duty, after his three days off, and was his second morning shift M1 (0550-1400) cycle. His M1 shift for the first day was normal.

The AIRPROX event took place approximately 55 minutes after the controller assumed duty at the Approach East position.

1.6. Aircraft Information

1.6.1 Aircraft Data- Diamond DA42

The Diamond DA42 is twin-engine low-wing cantilever monoplane, commonly used as a general aviation aircraft and for training purposes. It is equipped with a retractable tricycle landing gear arrangement and has a T-tail. The airframe is of composite material construction with a fuselage length of 8.56 meters (28 feet) and a wing span of 13.42 meters (44 feet).

Table 3 illustrates general data of the aircraft.

Table 3. DA42 Aircraft Data	
Aircraft Type:	DA42NG
Aircraft Manufacturer:	Diamond
Aircraft MSN:	42363
Max TO/Ldg Mass:	4,407 kg/4,407 kg
Date of the last C of A:	29 March 2017
Last C of A expiry date:	29 March 2018
C of A category:	Passenger
Aircraft Station License:	0145488/14
Insurance Validity Period:	16 November 2017
Last CMR date: 2012	6 October 2017
Next Due CMR	16 August 2018
TCAS System Details	TCAS I
Mode S:	G1000
Manufacturer	Garmin
P/N	190-00649-00

1.6.2 Aircraft Data – Embraer Phenom 100 (E50P)

The Embraer Phenom 100 (E50P) is an oval cross-section fuselage aircraft powered by two turbofan aft mounted engines. The low-wing T-tail aircraft has a pressurized cabin, with a vertical stabilizer and rudder. The speed is optimized for a maximum operating Mach number of 0.70. The E50P cabin height is 59 inches (1.5 meters) and the length is of 3.35 meters (132 inches) with six windows.

Table 4 illustrates general data of the aircraft.

Table 4. E50P Aircraft Data	
Aircraft Type:	EMB-500 Phenom 100 (E50P)

Aircraft Manufacturer:	Embraer
Aircraft MSN:	50000373
Max TO/Ldg Mass:	10,472 lb/9,766 lb
Date of the last C of A:	13 January 2017
Last C of A expiry date:	12 January 2017
C of A category	Passenger
Aircraft Station License	0195934/16
Insurance Validity Period	16 November 2017
TCAS System Details	TCAS I Model: GTS 850
Manufacturer	Garmin
P/N	011-01553-00

1.6.3 Aircraft traffic alert and collision avoidance system (TCAS I) installed

The E50P was equipped with TCAS I, which was limited to traffic advisories (TA) and not resolution advisories (RA). The TCAS of both aircraft were functional and serviceable and operated as per design specifications. The TCAS TA alert on the PFD was observed by the pilots of both aircraft. The pilots of E50P responded correctly to clear the conflict, whereas the DA42 pilots had no time to make any evasive manoeuvers.

1.7 Meteorological Information

1.7.1 The weather information at Al Ain International Airport (OMAL)

The Incident occurred during daylight conditions.

The weather report at Al Ain International Airport was CAVOK (Cloud and Visibility OK) with easterly light winds and a ground temperature of 28 °C.

Table 5 illustrates the meteorological Information for OMAL and table 6 illustrates the terminal aerodrome forecast (TAF) report.

Table 5. Meteorological information (METAR/SPECI) for Al Ain International Airport
METAR OMAL 152300Z 07004KT CAVOK 28/13 Q1010

Table 6. TAF information for Al Ain International Airport
TAF OMAL 15231313Z 1600/1706 VRB02KT 8000 NSC BECMG 1606/1608 26010KT BECMG 1613/1615 33005KT BECMG 1621/1623 VRB02KT PROB30 TEMPO 17013/1704 41300 HZ

1.8 Aids to Navigation

Ground-based navigation aids, on-board navigation aids, aerodrome visual ground aids, and their serviceability were not a factor in this Incident.

1.8.1 Radar snapshots of the AIRPROX

The following snapshots were taken from the radar recording and do not accurately represent exactly what the controller saw on the radar screen at the time of the Incident. In addition, the range scale varies between snapshots. The radar snapshot illustrated in figure 1 represents the calculated closest distance (approximate 0.5 nm/300 feet) between the aircraft at 0247:13LT. At that time, the E50P started to descend, upon receiving the instructions from

APPE ATCO to stop the climb at an altitude of 3,000 feet. At that moment, the E50P was climbing through 3800 feet for 5,000 feet is illustrated in figure 1.

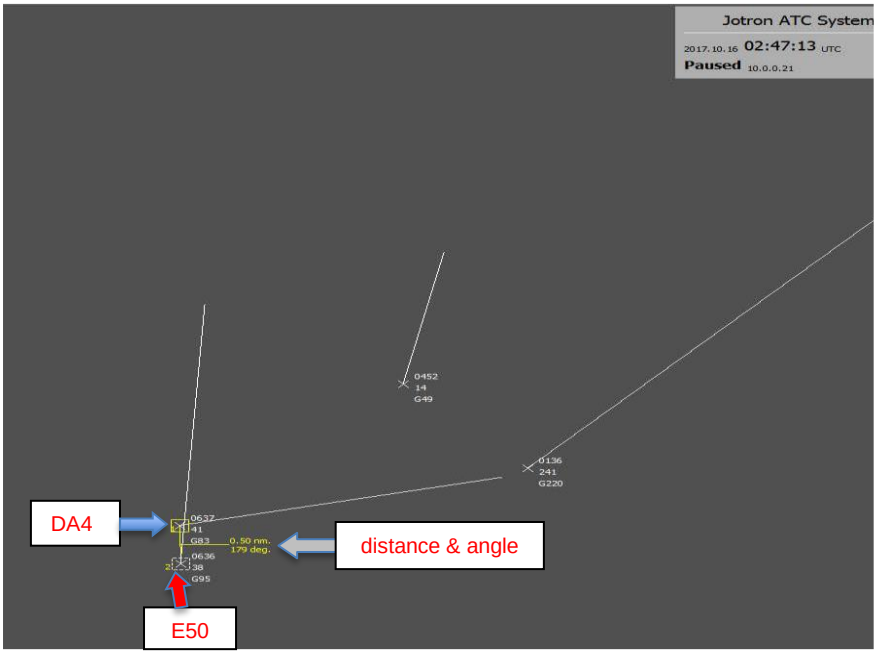

Figure 1. Radar snapshot at 02:47:13 UTC

The next radar snapshot indicates the time when the instructor pilot of the E50P reported having the DA42 visual. Approximately, at the same time the DA42 crew reported visual with the aircraft to their right hand side crossing below their aircraft. The time of the snapshot was 0247:18 and the DA42 was at 4,000 feet with the EP50 at 3,700 feet, the calculated horizontal separation was 0.30 nm and 300 feet and were crossing at the angle of 221 degrees at the right side of DA42 and 41 degrees of the E50P above the right wing (figure 2).

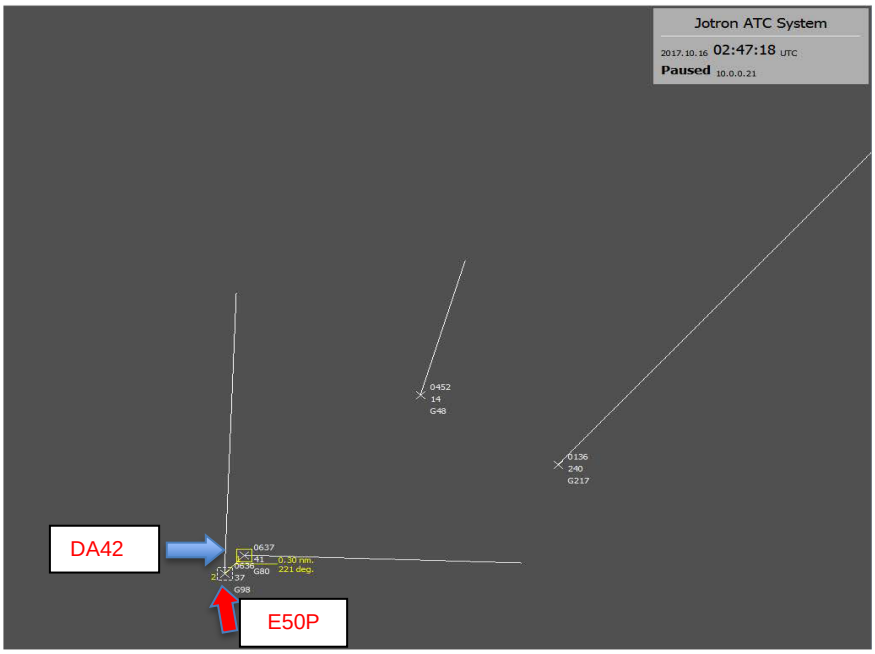

Figure 2 Radar snapshot at 02:47:18 UTC

The next radar snapshot (figure 3) represents the position of both aircraft at 0247:23 UTC indicating approximately when the E50P passed behind the DA42 with a

vertical displacement of 600 feet, and a horizontal separation of approximately 0.39 nm. The Minimum Separation Standard approved for use in the Approach East Zone was 1,000 feet vertical and 3 nm longitudinal by Radar. Both aircraft continued increasing the separation distance as the E50P continued climbing whereas the DA42 was maintaining altitude of 4,100 feet.

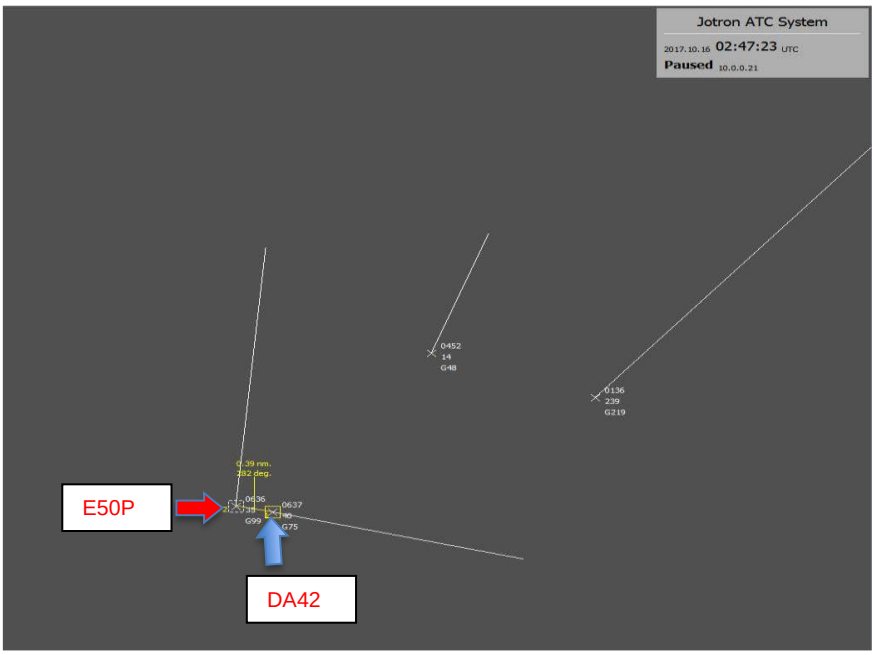

Figure 3. Radar snapshot at 02:47:23 UTC

1.9 Communications

All communications between air traffic service (ATS) and the two aircraft were recorded by ground based automatic voice recording equipment for the duration of the Incident. The quality of the recorded aircraft transmissions was good.

Both aircraft were equipped with two very high frequency (VHF) radio communication systems. Two of the VHF radios were used for routine communications with air traffic control, and the remaining set was dedicated to the aircraft communications addressing and reporting system (ACARS) data link system. All VHF radios were serviceable.

The ATC recordings and radar files were made available to the Investigation. In addition, throughout the following communications between APPE, Al Ain Tower and both aircraft, both aircraft pilots followed ATC instructions and the reads back by both aircraft pilots were clear and correct at all times.

1.10 Aerodrome Information

Al Ain International Airport is a GCAA certificated airport located 8 nm from Al Ain City, capable of IFR/VFR 24-hours operation. The airport's elevation is 869 feet, equipped with one asphalt runway 01/19 with concrete ends.

The elevation of runway 19 is 257 m (842 feet), Take-off run available (TORA) is 4,000 m (13,123 feet), take-off distance available (TODA) is 4,400 m (14,435 feet), accelerate-stop distance available (ASDA) is 4,000 m, landing distance available (LDA) is 4,000 m, and the width is 45 m (148 feet).

The true and magnetic bearing are 187/186 degrees respectively, with 1.3 degrees east magnetic variation. The runway slope is variable over the entire length from 0.62% to 0.07%, 1.3 degrees east.

1.11 Flight Recorders

The DA42 was equipped with a standard flight logger that was integrated into the Garmin G1000 avionics suite, and records 40 parameters every second. The E50P was equipped with a digital CVDR (mfg: L3 type: FA2100 GA) that records all information from sensors at 64/128/256/512 words per second (wps).

The flight recorders data was downloaded from both recorders by the aircraft manufacturer at the support facility of the Etihad Aviation Training maintenance hangar at Al Ain airport.

The flight paths derived from the flight recorders were examined during the Investigation. Refer to subsection 1.1 – *Sequence of events*, for relevant extracts from the recorded data. The occurrence sequence is described with reference to timeframes of elapsed time.

In addition, ATC recordings and the radar data complemented the flight recorder data in reference to the E50P pilots' actions to descend upon instructions from the APPE ATCO according to the recorded pitch attitude and radio altitude of the aircraft. The recorded coordinates and the altitudes of both aircraft resulted in the distances and closest proximity being measured.

1.12 Wreckage and Impact Information

No collision or impact occurred and no damage was sustained by either aircraft.

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this Incident, nor were they required.

Toxicological tests for common drugs and alcohol were not performed.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Not applicable.

1.16 Test and Research

The Investigation did not perform any tests and research.

1.17 Organizational and Management Information

1.17.1 Etihad Aviation Training (EAT)

Etihad Aviation Training (EAT), previously known as Etihad Flight College, is an approved aviation training organization based in Al Ain, Abu Dhabi, the United Arab Emirates. EAT operates in compliance with the *Civil Aviation Regulations* (*CAR) Part ORA, CAR FCL, CAR Part X*, and *the Civil Aviation Advisory Publication* (*CAAP*) *22*. The aviation training organization (ATO) is part of Etihad Aviation Group, and was created after Etihad acquired the fixed-wing component of Horizon. It received its initial *Aviation Training Organization Certificate* in December 2014, and the first training flights were conducted in January 2015.

EAT is delivering multi-pilot license (MPL) training to Emirati cadets on behalf of the customer company Etihad Aviation Group.

EAT possesses nine single engine Cessna (C172 Nav III), six Diamond (DA42) multi engine, four Embraer Phenom100 (E50P) jets used for primary training, and two Extra 330 aircraft for upset recovery training.

1.17.2 GAL Air Navigation Service (GAL ANS)

GAL ANS, formally a division of Global Aerospace Logistics, was air navigation service provider serving civil aviation in the United Arb Emirates including Al Ain International Airport. The following were the services provided:

- Air traffic control
- Aeronautical information
- Communication navigation surveillance
- Air traffic management consulting
- Air traffic services training
- Aerodrome operations maintenance
- Safety management systems
- Quality, health & safety, and environmental (QHSE) management systems
- Risk management

1.18 Additional Information

1.18.1 AIRPROX

With reference *ICAO Doc 4444 – PANS-ATM*, an AIRPROX is defined as "A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised."

ICAO defines a series of classifications for AIRPROX events which have been reported and subsequently investigated by an appropriate body. It is required that this classification be assigned on the basis only of actual risk, not potential risk. This means that only the residual risk after any avoiding action is considered.

The available classification categories are:

> "1. Risk of collision. The risk classification of an aircraft proximity in which serious risk of collision has existed. An AIRPROX Classification A may or may not be deemed to be a **serious incident** as defined by ICAO Annex 13.
>
> 2. Safety not assured. The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.
>
> 3. No risk of collision. The risk classification of an aircraft proximity in which no risk of collision has existed.
>
> 4. Risk not determined. The risk classification of an aircraft proximity in which insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination."

The definition and classification of an AIRPROX given above was agreed prior to the introduction of ground radar and airborne collision avoidance systems (ACAS) capable of measuring accurately the actual separation of the aircraft involved.

An AIRPROX may occur because of a level bust or airspace infringement. Safety nets such as ACAS and STCA mitigate the resultant risk of collision.

1.18.2 Reporting and investigation of an AIRPROX

ICAO requires the establishment of AIRPROX reporting and investigation procedures and these should be specified in national procedures.

Typically, national authorities establish a special committee to investigate an AIRPROX report which allocates the actual risk classification and recommends further action. Some States use their *Annex 13* accident investigation authority to also investigate all AIRPROX occurrences, not just those which are considered to be a serious incident.

An AIRPROX should be reported as soon as possible to facilitate investigation of the incident. If circumstances allow, the pilot should report the incident immediately to ATC using radiotelephony, the details will then be reported by ATC to the appropriate body. If it is not possible to report an AIRPROX in flight (e.g. because the frequency in use is too busy), the pilot should report the incident as soon as possible after landing. ATS units to whom AIRPROX incidents are reported should also report the circumstances of which they are aware to the appropriate body. In all cases, initial verbal reports should be followed up by full written reports using any prescribed form which may be in use for that purpose.

Depending on circumstances, an AIRPROX may qualify as a serious incident which will then require that it be reported to, and investigated by, a national accident investigation authority, under the terms of ICAO *Annex 13*. Non-*Annex 13* AIRPROX investigations are essentially a special case of a State mandatory occurrence reporting and follow-up by, or in association with, the applicable regulatory authority under the terms of ICAO *Annex 13* Chapter 8, whereas an *Annex 13* Investigation is independent of regulatory influence.

1.18.3 Airborne collision avoidance system (ACAS)

1.18.3.1 General description[2]

An airborne collision avoidance system (ACAS) operates independently of ground-based equipment and air traffic control in warning pilots of the presence of other aircraft that may present a threat of collision. If the risk of collision is imminent, the system initiates a maneuver that will reduce the risk of collision. ACAS standards and recommended practices are mainly defined in annex 10, volume IV, of the Convention on International Civil Aviation. Much of the technology being applied to both military and general aviation today has been undergoing development by NASA and other partners since the 1980s.

1.18.3.2 International standards for ACAS

ICAO is responsible for the global standardization of ACAS.

ACAS equipment is available from different vendors. While each vendor's implementation is slightly different, they provide the same core functions and the collision avoidance and coordination logic contained in each implementation is the same. In order to be certified, ACAS equipment must meet the Minimum Operational Performance Standards (MOPS) laid down in the Radio Technical Commission for Aeronautics (RTCA) requirements and the forthcoming European Organization for Civil Aviation Equipment (EUROCAE) documents.

The equipment which meets the ACAS II *Standards and Recommended Practices (SARPs)* set in *Annex 6* is known as TCAS II, version 7. A joint RTCA/EUROCAE working group has finalized amendments to the MOPS, addressing three specific safety improvement changes related to the collision avoidance logic; these new MOPS will form TCAS II version 7.1 and are published as *RTCA DO-185B* and *EUROCAE ED-143*.

[2] https://www.skybrary.aero/index.php/ACAS

1.18.3.3 The United Arab Emirates standards for ACAS

The requirements for the ACAS are mentioned in *CAR-OPS 1.668*, and the *CAAP 29*. *CAR-OPS 1* mandates ACAS II without version standardization.

CAR-OPS 1.668 states[3]:

> "Airborne Collision Avoidance System:
>
> (a) An operator shall not operate a turbine powered aeroplane:
>
> (1) Having a maximum certificated take-off mass in excess of 15000 kg or a maximum approved passenger seating configuration of more than 30 after 1 January 2000; or
>
> (2) Having a maximum certificated take-off mass in excess of 5700 kg, but not more than 15000 kg, or a maximum approved passenger seating configuration of more than 19, but not more than 30, after 1 January 2005, unless it is equipped with an airborne collision avoidance system with a minimum performance level of at least ACAS II."

1.18.3.4 Types of ACAS

ACAS I - Gives TAs but does not recommend any collision avoidance maneuvers. The only implementation of the ACAS I concept is TCAS I. ICAO *SARPs* for ACAS I are published in *Annex 10*, volume IV, but are limited to interoperability and interference issues with ACAS II. ACAS I is mandated in the United States for certain smaller aircraft.

ACAS II gives TAs and RAs in the vertical sense (direction). ACAS II *SARPs* are published in *Annex 10*. The only implementation of ACAS II concept is TCAS II Version 7.0.

The types of TCAS II are:

- TCAS II version 6.04a – old version of TCAS II, never mandated in Europe but still used by some military aircraft or foreign aircraft (which do not fall within the current European mandate)
- TCAS II version 7.0 – currently mandated in Europe but to be gradually phased out and replaced by version 7.1
- TCAS II version 7.1 – mandated in Europe as per *EU regulations 1332/2011*:
  - for all new aircraft as of 1 March 2012
  - and for all aircraft currently with version 7.0, before 1 December 2015.

1.18.4 Air Traffic Control Alerting System

1.18.4.1 Safety nets for ATC

Listed are some of the ground safety nets that are utilized across ATC centers in order to aid ATCOs in performing their jobs safely, especially with the demands of air traffic:

- Short Term Conflict Alert (STCA), which assists the controller in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima.
- Minimum Safe Altitude Warning (MSAW), which warns the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.
- Area Proximity Warning (APW), which warns the controller about unauthorized penetration of an airspace volume by generating, in a timely manner, an alert

[3] Revision date - Reissue 01 July 2011

of a potential or actual infringement of the required spacing to that airspace volume.

- Approach Path Monitor (APM), which warns the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles during final approach.

1.18.4.2 Short term conflict alert (STCA)[4]

The STCA is a function integrated into an ATC radar system. It assists the controller in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima. In the STCA function, the current and predicted positions of aircraft with pressure altitude reporting capability are monitored for proximity. If the distance between the positions of two aircraft is predicted to be reduced to less than the applicable separation minima within a specified time, a warning will be generated to the controller. The parameters for determining when STCAs are generated are left for the local ANS unit to define based on fine tuning out nuisance alerts.

There is no direct connection that exists between STCA and ACAS II although the aircraft transponder provides data for both the TCAS II computer and the ATC radar system. Although normally very effective in alerting controllers about actual or potential separation loses, STCA is not as efficient as ACAS II in providing collision avoidance.

1.18.4.3 ATS surveillance services –*CAR Part VIII 4.34(c)* and ICAO *Document 4444*

As stated in the CAR Part VIII – Air Navigation Regulations, subpart 4.34[5]:

"(c) The applicant for an air traffic service certificate shall establish procedures to ensure that, where radar or automatic dependent surveillance is used to support the provision of an air traffic service:

1. All surveillance separations are in accordance with the requirements of Appendix A.1 and PANS -ATM;
2. Mode A SSR code allocation shall be made by the ATC units in accordance with the Originating Region Code Assignment Method ORCAM11F6 allocation procedures.
3. Full information is made available to pilots and aircraft operators on:
   i. The nature and extent of the surveillance services provided;
   ii. Any significant limitations regarding such surveillance services;
4. The information displayed at individual surveillance operating positions is that required for the air traffic services to be provided, including the display of safety related alerts and warnings, where the Authority has determined that the facility is required; and
5. The surveillance system used shall be provided and maintained in accordance with the provisions of Subpart 5 of the Civil Aviation Rules."

Reference for ATS surveillance systems capabilities with safety related alerts and warnings is also highlighted in ICAO *Document 4444 PANS-ATM*[7], 8.1.4, 8.4.1, 15.7.2[8]

4 Information downloaded from: https://www.eurocontrol.int/articles/resources , dated 2 Nov 2007.
5 Revision November 2009
6 SSR codes used by Air Traffic Control for radar services
7 Procedures for Air Navigation Services Air Traffic Management
8 Fifteenth Edition, dated 2007, downloaded 31 December 2017

1.18.4 Civil Aviation Regulations on HF training for air traffic controllers

Human Factor training and principles are mentioned in *CAR Part VIII, Subpart 4*[9]*– Air Traffic Control Organizations*:

CAR 4.35 – Aircraft Emergencies and Irregular Operations, states:

> "(c) In communications between ATS units and aircraft in the event of an emergency, Human Factors principles, as shown in ICAO Document 9683, should be observed."

Appendix 2.1 – *ATC Course Approvals*, states:

> "(c) Training courses for ATS personnel shall:
>
> 1. take due regard of Human Factors requirements, as contained in ICAO Documents 9683 and 975815F[10],
> 2. take due regard for Threat and Error Management, as contained in ICAO Circular 314[11]."

Appendix 2.7– *Continuation Training Requirements*

> "(d) ATC courses shall include the following:
>
> 6. Human Factors principles, in relation to communication between ATS units and aircraft subject to emergencies."

Appendix 2.10 – *Competence of Air Traffic Controllers*

> *"k) Before a CoC [certificate of competency] is issued or renewed an air traffic controller shall demonstrate satisfactory competence in the following areas by completing a CoC examination.*
>
> *1. Satisfactory knowledge in the following subjects:*
>
> *iv. human factors, fatigue, and threat and error management relevant to Air Traffic Control including handling of an aircraft in an emergency."*

Appendix 3.6 –*Required Knowledge, Skills and Experience*

> "(a) The knowledge required to be demonstrated by an air traffic controller or a student air traffic controller, shall be at an appropriate standard for a holder of an Air Traffic Controller Licence, and include at least the following subjects:
>
> 4. Human Factors, performance limitations, e.g. fatigue, relevant to ATC."

1.19 Useful or Effective Investigation Techniques

This Investigation was conducted in accordance with the *Civil Aviation Law* and *Regulations* of the United Arab Emirates, and the AAIS-approved policies and procedures, and in accordance with the *Standards and Recommended Practices* of *Annex 13* to the Chicago Convention.

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9 Issue 03 Revision 00, date of Issue June 2014, date of Revision June 2014.

10 ICAO *Document 9683* is the Human Factors Training Manual, and *Document 9758* is the Human Factors Guidelines for Air Traffic Management.

11 ICAO *CIR 314* Treat and Error Management (TEM) in Air Traffic Control. This circular describes an overarching safety framework intended to contribute to the management of safety in aviation operations and known as TEM. The main objective of introducing the TEM framework to the ATS community in general, and the ATC community in particular, is to enhance aviation safety and efficiency. This is achieved by providing an operationally relevant and highly intuitive framework for understanding and managing system and human performance in operational contexts.

2. Analysis

2.1 General

Available investigation literature shows that TCAS TAs occur during routine operations. However, TCAS TAs may lead to an unsafe condition, especially when both aircraft take 'avoidance action'.

The analysis will discuss the issues identified during the Investigation as being the most significant issues such as: recommended training for air traffic controllers, Aviation Training Organization, flight training operations. Abu Dhabi Radar Approach East (APPE) Short term conflict alert (STCA), actions taken by the pilots and the air traffic controllers, and the airspace environment.

This part of the Report explains the contribution of each Investigation aspect to the occurrence. The analysis also contains safety issues that may not be contributory to the Incident, but are significant in adversely affecting safety.

The latent conditions[12] prevailed in the ATC procedures in handling the training IFR or VFR flight rules responsibilities between the APPE and the ADC. This Incident has highlighted deficiencies in procedures that created situations for active ATC failures[13] and unintentional errors to occur.

Both aircraft were equipped with the TCAS I system and both systems were serviceable.

2.2 Air Traffic Services Operations Manual

2.2.1 OMAA local air traffic services instructions (LATSI), section 3, chapter 1

"8.9 Missed Approaches – IFR Aircraft
- 8.9.1 Published Missed Approach.
- 8.9.2 IFR Aircraft will normally carry out a missed approach as published on the relevant instrument approach charts.
- 8.9.3 Non-Standard Missed Approach.
- 8.9.4 Any non-standard missed approach (other than a Published Missed Approach procedure) issued by a controller, must be in the form of a procedural clearance only and shall not include radar headings or any instruction to manoeuver to the East of ALN. Any altitude assigned must be at or above the relevant MVA. Nonstandard missed approach instructions shall be coordinated between APP and ADC.
- 8.9.5 Note: In all cases, Al Ain APP shall ensure that any IFR aircraft conducting a nonstandard missed approach remains laterally clear of and/or 1000ft above the ATZ (or any other airspace delegated to ADC).

8.10 Missed Approaches - VFR Instrument Training Aircraft – OMAL ADC
- 8.10.1 Aircraft Missed Approach Request.
- 8.10.2 Al Ain ADC shall not issue a Published Missed Approach upon request from a VFR instrument training aircraft. When a VFR instrument training aircraft requests to follow a Published Missed Approach (either from a go-around or on departure)."

ADC shall instruct the aircraft to climb on RWY heading to A025."

[12] 2.3.3 Latent conditions are those that exist in the aviation system well before a damaging outcome is experienced. The consequences of latent conditions may remain dormant for a long time. Initially, these latent conditions are not perceived as harmful, but will become evident once the system's defenses have been breached.
Ref.: *ICOA doc. 9859 Chapter 2 Safety Management Fundamentals.*

[13] 2.3.2 Active failures are actions or inactions, including errors and violations, which have an immediate adverse effect. They are generally viewed, with the benefit of hindsight, as unsafe acts. Active failures are generally associated with front-line personnel (pilots, air traffic controllers, aircraft mechanical engineers, etc.) and may result in a harmful outcome.
Ref.: *ICOA doc. 9859 Chapter 2 Safety Management Fundamentals.*

The APPE ATCO inactions as per the procedure manual; changing the cleared-to-level on the radar label to Altitude 025 (A025) and did not issue E50P an alternate missed approach clearance. The APPE ATCO did instruct the ADC ATCO to issue E50P and alternate missed approach clearance.

The ATC area microphone recording revealed a discussion between the APPE ATCOs (involved ATCO and one of his colleagues), and mentioned that the involved ATCO believed the E50P flight was a VFR Flight.

During HOW/TOW (handover of work/ takeover of work), the outgoing ATCO informed the incoming ATCO (involved ATCO) that the E50P was an IFR flight and the PF did not want to change to VFR. It is likely that the involved ATCO did not notice the flight strips, which indicated that the E50P was an IFR flight.

2.2.2 IFR arrivals and phenom activities at the OMAL

The *LATSI* has laid down following references:

ATSOM Part 2 Section 1 – Unit Operation Procedures:

> "1.3.8 Instrument Flight Rules (IFR) Arrivals and Departures:
> Ref: Operational LOA between Al Ain App-R and ADC,
> 6. IFR Arrivals and Departures, dated 1 Jan 2016."

ATSOM Part 2 Section 3 – Civilian Procedures

> "3.1.14 Phenom 100 Procedures
> a. Phenom 100 departure and arrival
> b. The flight rule of the training flights for these aircraft are IFR and each training flight will operate 2 to 3 hours
> c. The Phenom 100 will operate out of slots. If a flight rule change from IFR to VFR, will support the ATC operation at Al Ain International Airport we are able to initiate this on the radio
> c. If the flight rule needs to be changed make this clear on the frequency by using the following phrase:
> i. "I consider you now as VFR"
> 1. The change of flight rule has to be coordinated with approach."

Since the E50P was operating in IFR, as per the above procedures, the ADC ATCO was not required to issue an alternate missed approach procedure.

2.2.3 OMAA-OMAL letter of agreement (LoA)

Document number OMAA-ATC-D029, version 1.0, stated that:

> "2.2 PROCEDURES
> 2.2.7 Standard Missed Approach instructions will be "Runway Heading A025" and no coordination required unless alternate missed approach instructions are needed.
> 9.4 VFR Instrument Training
> c) Standard missed approach instructions (fly runway heading maintain A025) shall be issued by ADC, to all aircraft on VFR Instrument training flights, no coordination required unless other than standard missed approach instruction are issued."

These procedures above do not specify the following:

- Who is responsible for issuing the standard missed approach instruction, whether it is the APPE or the ADC ATCO
- The applicability of the procedure to which flight rules is not clear:
  - IFR flights,
  - VFR instrument training flights,
  - IFR training flights, or

- All of the above.

In addition, item 9.4 c) specifically states that the ADC is responsible for issuing the standard missed approach instruction to VFR instrument training flights.

2.3 Actions by the Pilots

The pilots of both aircraft followed the ATC clearances provided and performed as expected by the traffic conflict recovery procedures. They maintained their situational awareness[14], which assisted in good decision-making and airmanship. The E50P instructor pilot responded by taking control and descending the aircraft to a safe altitude below the DA42. The DA42 maintained altitude and did not conflict with the E50P movement.

2.4 Actions by the Air Traffic Controllers (ATCOs)

The APPE ATCOs took over his position and shortly thereafter, he had to manage and control the two aircraft that were flying in his area of control.

However, in this case, the ATCO identified the conflict before the TCAS TA alert annunciation and he instructed the pilot to take appropriate action to avoid a conflict. During the avoidance action the TCAS TA alert message was displayed on the PFDs of both aircraft. The avoidance policies were adhered to by both training instructors involved in this AIRPROX Incident.

2.5 Fatigue

The Investigation did not reveal any fatigue, tiredness or any other factor, that prevented the ATCOs from performing their duties and maintaining the required separation between the two Aircraft.

[14] Situation awareness is defined as “The perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future” in Endsley, M. R. (1995b). Toward a theory of situation awareness in dynamic systems. Human Factors, 37(1), 32–64.

3. Conclusions

3.1 General

As of the evidence available, the following findings, causes and contributing factors were made with respect to this Incident. These shall not be read as apportioning blame or liability to any particular organization or individual.

To serve the objective of this Investigation, the following sections are included under the conclusions heading:

- **Findings.** Statements of all significant conditions, events or circumstances in this Incident. The findings are significant steps in this Incident sequence but they are not always causal or indicate deficiencies.
- **Causes.** Actions, omissions, events, conditions, or a combination thereof, which led to this Incident.
- **Contributing factors.** Actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 Findings related to both aircraft

(a) Both aircraft had valid certificates of airworthiness and were certified, equipped, and maintained in accordance with the existing the *Civil Aviation Regulations* of the United Arab Emirates.

(b) Both aircraft were airworthy when dispatched for the training flight.

(c) There was no evidence of any airframe defect on either aircraft that could have contributed to the Incident.

(d) The traffic collision avoidance system of both aircraft were serviceable and operated correctly indicating traffic advisory alerts to both aircraft pilots.

(e) The closest that the two aircraft came to each other was 0.5 nm lateral and 300 feet vertical.

3.2.2 Findings related to the pilots

(a) The cadet pilots and the instructor pilots were medically fit, qualified for the training program and adequately rested to operate the flight, in accordance with existing *Civil Aviation Regulations*.

(b) The pilots were in compliance with the training flight duty time regulations.

(c) There was no evidence that incapacitation or physiological factors affected the pilots' performance.

(d) There was no evidence that the pilots suffered any sudden illness or incapacity which may have affected his ability to control the aircraft.

(e) Toxicological tests for common drugs and alcohol were not performed.

(f) Based on the available reports and information, there was no evidence to indicate that the pilots' performance was degraded by psychological factors.

(g) The E50P instructor pilot actions were appropriate and timely while responding to the traffic conflict information passed by the APPE ATCO.

(h) Both flights were following predetermined clearances.

(i) The DA42 pilots continued to be on holding pattern without any deviation.

3.2.3 Findings related to the flight training academy

(a) The academy was in compliance with *CAR Part ORA, CAR FCL, CAR Part X,* and *CAAP22.*

3.2.4 Findings related to ATC

(a) During the shift change HOW/TOW procedure from night shift to morning shift, the on-coming APPE ATCO was informed that the E50P was operating an IFR flight plan and PF did not change to VFR. The ATC recording revealed that in APPE ATCO's (involved ATCO) perception, the E50P flight was a VFR flight.

(b) When the E50P reported established on the ILS runway 01, the APPE ATCO provided the clearance for the missed approach, and requested the EP50 to contact the ADC. The APPE ATCO did not give an altitude restriction to protect the DA42 which was en-route to hold at ALN A040.

(c) When the E50P reported its intention to carry out a missed approach, the APPE ATCO did not use ICAO radio transmission phraseology *"that shouldn't be a problem"*.

(d) After transferring E50P to ADC, the APPE ATCO changed the cleared-to-level on the aircraft's radar label to A025 but did not call the ADC to issue an altitude restriction.

(e) When the E50P reported passing A032 for A050 and requested radar vectors for ILS runway 01, the APPE ATCO identified the conflict and resolved it by passing information to the EP50 to stop the climb at A030.

(f) The APPE ATCO did not report the Incident to the shift supervisor nor did he file an incident report in the unit, or with ROSI.

(g) The APPE ATCO did not discuss the Incident with the pilot or the ADC involved in this Incident.

(h) Fatigue was not observed in this Incident.

3.3 Causes

The Air Accident Investigation Sector determines that the cause of this AIRPROX Incident was the loss of minimum separation between the two aircraft, while following instructions provided by ATC.

3.3.1 Contributing factors

Contributing factors to this Incident were:

(a) The LoA (2.2 Procedures) between APPE and OMAL does not contain clear instructions to manage IFR training flights nor does it state who was responsible for issuing the standard missed approach instructions.

(b) IFR arrivals and Phenom Jet trainer operations by Etihad Aviation Training was discussed exclusively in OMAL *LATSI*, Part 2, Section 1 – *Unit Operation Procedures*, but it was not mentioned in the APPE *LATSI*.

(c) The APPE ATCOs perception that the E50P flight was a VFR flight and not an IFR flight, which he interpreted to mean that the E50P would follow standard VFR missed approach instructions and he anticipated that the ADC would issue instructions (fly runway heading maintain A025), no coordination is required unless other than standard missed approach instructions are issued.

(d) The APPE ATCO did not notice that the E50P was an IFR flight, despite this information being correctly and clearly displayed on the Flight Strip for E50P.

4. Safety Recommendations

4.1 General

The safety recommendations listed in this Report are proposed according to paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation* and are based on the conclusions listed in part 3 of this Report, the GCAA expects that all safety issues identified by the Investigation are addressed by the receiving States and the organizations.

4.2 Safety Action Taken (Preventive Actions Taken)

GAL Air Navigation Services:

- Has established an internal investigation board whose membership represents ANS Operations, Training and Standards and Safety. The board proposed to GCAA-ANS the following action plan to return the APPE ATCO to normal operational duties. These actions were accepted by the GCAA:
    - The APPE ATCO would undergo the following remedial program:
        - Classroom briefing/presentation covering:
            - Incident reporting,
            - Application of procedures,
            - Submitting of ROSI
            - SMS,
            - Managing IFR training aircraft
        - Minimum of 2 hours On-Job Training (OJT), and
        - A full Compliance of Competency (CoC)
- The APPE ATCO would return to normal operational duties only after successfully completing the above program.
- Management of OMAA and OMAL required to conduct a priority collaborative review of the operational documentation.
- GAL published a Temporary Instruction (Ref.No.:TI 247/17) *Radar East Missed Approach/Go Around Procedures* on 19 October 2017 for OMAL APP.

4.3 Final Report Safety Recommendations

The Air Accident Investigation Sector recommends that:

4.3.1 GAL Air Navigation Services

SR09/2019

OMAA and OMAL management review and correct the LoA for the handling and responsibilities related to the standard missed approach instructions with applicability to the following flights;

- IFR flights,
- VFR instrument training flights,
- IFR training flight.

The Objectives of the review should be to ensure that the LoA clearly defines the responsibilities of both OMAA APPE and OMAL ADC, and to ensure that both the procedures for OMAA and OMAL are aligned and correctly documented.

SR10/2019

based on the events of this Incident and conclusion of this Report, develop a training scenario to be incorporated in their training curricula, for both initial and recurrent training, that raises human factors awareness for:

(a) Communication deficiencies and incomplete information transfer during handover;

(b) Maintaining focus, and scanning to increase situational awareness;

(c) Challenges in provision of clear, unambiguous inter/ intra unit coordination;

(d) Reactions and startle effect and delivering appropriate avoiding instructions in the event of an AIRPROX;

(e) Correct pilot notification and Incident Reporting Process, in the event of an Incident.

4.3.2 The General Civil Aviation Authority of the United Arab Emirates

SR11/2019

Conduct an acceptance review of the amended OMAA and OMAL procedures for handling and responsibilities related to the standard missed approach instruction and applicability for the following flights:

- IFR flights,
- VFR instrument,
- IFR training flight.

To ensure the procedures are appropriately aligned and correct for both OMAA and OMAL.

Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

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