Aviation Safety Council

Taipei, Taiwan

GE222 Occurrence Investigation
Factual Data Collection
Group Report

Flight Operations Group

December 26, 2014

ASC-FRP-14-12-01

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Contents

I. Team Organization

Chairman:
Captain Norman Li-Ya Pin Aviation Safety Council (ASC), Taiwan ROC
Members:
1. Cobra Wen-Huan Chang Aviation Safety Council (ASC), Taiwan ROC
2. Captain Yen-Ping Chang Aviation Safety Council (ASC), Taiwan ROC
3. Captain Richard Fu Civil Aeronautics Administration (CAA), Taiwan ROC
4. Captain Jerome Bonetto ATR, France
5. Capt Chih-Li Yang TransAsia Airways

II. History of Activities

Date	Activities
7/24/14 to 7/27/14	1. Completed part of the on scene investigation, including the preliminary examination of final approach path, the new found area of impact, and major wreckage site. 2. Gathered evidence from cockpit instrument panel and the control column (switch), 3. Interviewed some witnesses, personnel of Air Force Weather Agency and ATC (Air Traffic Control) tower. 4. Secured the relevant documents of flight records. 5. Cockpit front panel and throttle quadrant rebuild planning with TransAsia personnel. Cockpit parts and wreckages recovery and relocation. Found suitable contractor to rebuild aircraft from wreckage. 6. Accompany BEA, ATR and PWC representatives to perform wreckage site survey and wreckage examination.
7/28/14	1. Enlisted CAA, TNA Group adviser, discuss collaboration plan. CAA- RCQC VOR 20 flight test; policy for Continuous Descent Final Approach (CDFA) during non-precision approach. TNA- FOQA(Flight Operations Quality Assurance) records requirement, documents requirement. Training records, programs and manuals are first priority. 2. Decided the initial required documents from CAA, TNA. Will notify TNA with official letter. CAA is to provide the TNA inspection records. 3. Liaised with UNI Airways for flight crew interview. 4. Collaborated with BEA, ATR representatives in confirming contents integrity of FDR (Flight Data Recorder) read-outs and rationalize the history of flight profile.
7/29/14	1. Finalized the Flt ops Group advisers of CAA, TNA. 2. Final rationalization of the history of flight profile with BEA, ATR.

Date	Activities
	3. Liaised with UNI Airways for flight crew interview.
7/30/14	1. Checked and accepted TNA manuals. 2. Collected information from UNI 647 and GE220's flight profile. 3. On ATC group chairman guide, liaised with Kaohsiung ATC for interview. 4. Confirmed flight crew's general whereabouts by their 72 hrs. roster and the usage of dormitory.
7/31/14	1. Completed the interview for Kaohsiung approach ATC with ATC group chairman. 2. Retrieved the shipment of fuel from Kaohsiung harbor
8/1/14	Worked out a plan for the TNA observation flights to confirm the company safety culture adopted by flight crew: (1) Adhering to FOM. (2) Follow SOP (Standard Operating Procedures). (3) Use of checklists (4) FMA (Flight Mode Annunciation) callouts. (5) Set of missed approach altitude
8/4/14	Completed TNA 3 observation flights (6 legs) (1) TSA-HLN (2) TSA-MKG (3) TSA –KNH
8/5/14	1. Group meeting to discuss the TNA flight observation results on which to put future emphasis. (1)TSA-HLN (2)TSA-MKG (3)TSA –KNH 2. Completed the interview flight crew of UNI Airways 647 preceding Flight GE222. 3. Collected RCQC VOR RWY20 flight test results from CAA. 4. Conducted initial review of CVR and its transcript.

Date	Activities
8/6/14	1. Group meeting to discuss CAA RCQC VOR RWY20 flight test results. 2. Preliminary group discussion about CVR(Cockpit Voice Recorder) transcript. 3. Flight ops group chairman reached a joint decision with flight recorder group chairman to verify CVR transcript on next Monday morning (8/11), altogether with CAA and TNA members.
8/7/14	1. Group meeting to set up new focus for TNA RCQC observation flights. 2. Interviewed CAA personnel in charge of the chart design for RCQC VOR RWY20. 3. Interviewed CAA Navaid flight test pilots and engineer for RCQC VOR RWY20 technical test result.
8/8/14	1. Completed TNA 3 observation flights (TSA-MKG total 6 legs) 2. Monitored signal stability and validity of MKG VOR RWY20 APP.
8/11/14	Initial worked out CVR transcript with recorder group, CAA and TNA.
8/12/14	1. Attended ASC GE222 investigation progress meeting 2. Worked out main themes for interviewing flight crew of ATR72-500 fleet with organization group
8/13/14	Finalized CVR transcript with recorder group, CAA and TNA.
8/14/14	Joint interview flight crew of ATR72-500 fleet with organization group.
8/15/14	Attended ASC GE222 investigation progress meeting.
8/20/14	1. Conducted TNA observation flights (TSA-MKG, 2 legs) 2. Joint interview flight crew of ATR72-500 fleet with organization group.
8/22/14	Conducted TNA observation flights.

Date	Activities
8/27/14	Conducted TNA observation flights(TSA-MKG, 2 legs).
8/28/14	Conducted TNA observation flights(TSA-MKG, 2 legs)
8/29/14	Conducted TNA observation flights
9/2/14	Assisted and verified recorder group's initial English version CVR transcript
9/5/14	Discussed with recorder and maintenance group about the RCQC runway location in NDB 20 approach chart, and requested to secure GE222 Navigation Data Base.
9/9/14	1. Conducted Dispatcher interview. 2. Reviewed and compared the approach charts between Jeppesen's and AIP's (Aeronautical Information Publication).
9/10/14	Reviewed TNA FOM and flight crew information
9/11/14	Discussed the TNA FOM & FTMM with TNA chief pilot.
9/12/14	1. Reviewed and compared the CVR transcript with ATC's. 2. Initiated and drafted the sequence of events.
9/22/14	Interviewed CAA chart design officer for the second time
9/26/14	Interviewed CAA Operations Section Manager of Flight Standards Division for the second time
10/1/14	Attended ASC GE222 investigation progress meeting, presented initial GE222 sequence of events.
10/11/14 to 10/16/14	Went to BKK to observe TransAsia Airways (TNA) part of initial and recurrent simulator trainings:
10/20/14	Attended ASC GE222 investigation progress meeting, discussed the trip to France to conduct flight test in the FFS and engineering simulation.
11/5/14 to	1. Three simulator sessions were conducted in Toulouse to study the EGPWS alerts of GE 220/GE 222 and GE 222 performance and aircraft behavior under different

Date	Activities
11/7/14	conditions. 2. EGPWS and VOR mode meeting with ATR design office 3. Engineering simulation meeting with ATR design office 4. SOP meeting with ATR Flight Operations

III. Factual Description

1.1 History of Flight

On July 23, 2014, about 1906[1] Taipei Local Time, TransAsia Airways (TNA) passenger flight GE 222, an ATR72-212A, B-18210, crashed short of runway during a VOR non precision approach to runway 20 at Magong Airport (RCQC), Penghu, Taiwan.(Figure 1.1-1) The airplane was destroyed by impact forces and post crash fire. Forty eight of the 58 airplane occupants, including 2 flight crewmembers, 2 cabin crewmembers and 44 passengers, were fatally injured. The other 10 passengers received serious injuries. Five residents on ground received minor injuries.

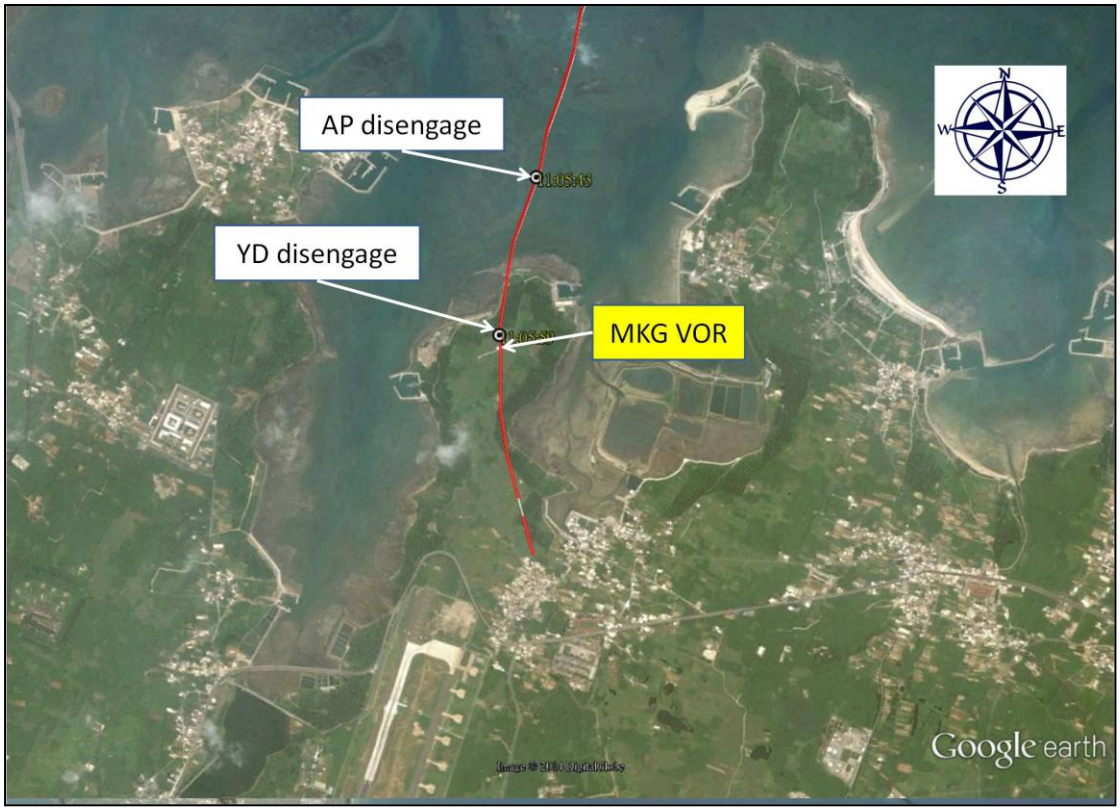


Figure 1.1-1 Final approach ground track

According to Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR), Kaohsiung Ground Control had informed GE 222, RCQC weather was below landing minimum. The flight crew chose to continue their flight and to hold in flight. The aircraft took off from Kaohsiung International Airport at 1745:02, facing west and then northbound to Magong airport. It

[1] Unless otherwise noted, all times in this report are Taipei Local Time based on a 24-hour clock.

climbed and cruised at 7,000 feet (QNH 1000). The autopilot (AP) was engaged with left coupling. The aircraft was vectored and entered a holding at 1811:17 for about 34 minutes. The flight crew requested twice for ILS RWY02 approach and prepared it during holding but the ATC answered “standby for coordination with magong tower”.

At 1830, the visibility reported in the RCQC ATIS M was 800 meters. At 1840, the visibility reported in the new ATIS N was 1,600 meters.

At 1855:10, GE 222 was cleared for VOR RWY20 approach from approximately 3000 feet (QNH 1000) descending to 2,000 feet (QNH 1000) around 25 Nautical Miles(NM) North East from the airport.

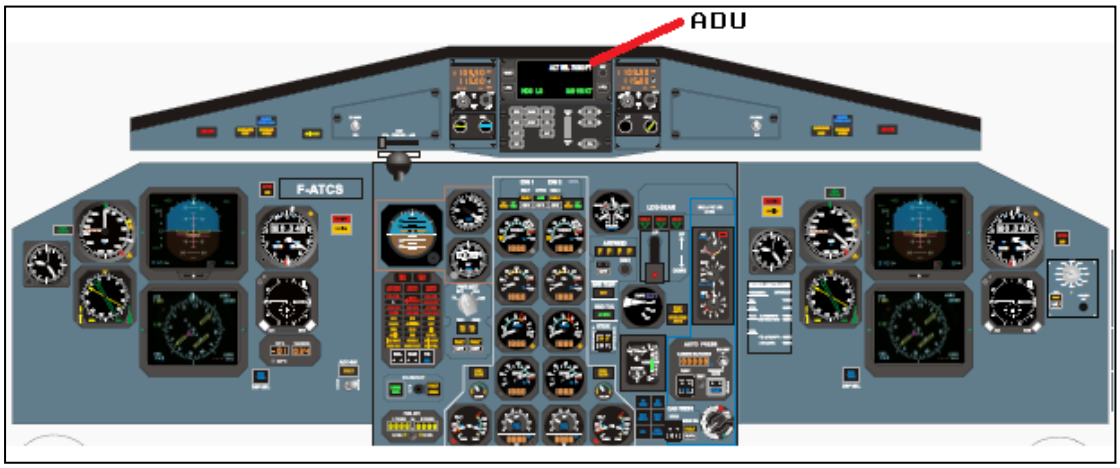


Figure 1.1-2 ADU

At 1856:31, LNAV mode[2] was engaged for 7 seconds with VS mode engaged.

At 1856:38, No AFCS (Automatic Flight Control System) lateral mode was engaged.

At 1858:36, VOR armed mode was displayed on the Advisory Display Unit (ADU) (Figure 1.1-2) with selected course 209° and selected heading 229°.

At 1859:03, the selected course was set to 201°.

At 1859:21, ALT SEL (preselect) was set to 400 feet on the ADU .

At 1900:27, No AFCS lateral mode was engaged for 13 seconds and then HDG mode remained disengaged for 6 seconds with VOR armed mode

[2] All AFCS modes are explained in detail in section 1.6.1 Automatic Flight Control System

engaged.

At 1900:26, engine 1 torque was set to 54% and engine 2 torque was set to 48%. The airspeed was 170 knots and the magnetic heading was 227°. At 1901:00, the green VOR*(VOR CAPTURE mode) was displayed on the ADU. At 1901:30, the green VOR (VOR TRACK mode) was displayed on the ADU.

At 1902:47, the crew started the descent from 2,000 feet (QNH 997), AP was engaged in VOR and VS mode and then flaps were set to 15. At 1903:07, the aircraft passed the Final Approach Fix (FAF) at 1,855 feet (QNH 997). At 1903:35 the landing gear was extended and then flaps were extended to 30°.

At 1903:39, GE 222 was cleared to land and wind reported by ATC controller was 250°/19 knots.

At 1905:09, synthetic call out 500 feet was heard on the CVR, passing altitude 479 feet (QNH 997), the green ALT* (ALT SEL CAPTURE mode) was displayed on the ADU. At 1905:12, the captain said "um three hundred" and then ALT SEL was set to 300 feet on the ADU associated to a reversion to basic mode (pitch hold mode). At 1905:15, VS HOLD mode is reselected on the ADU with -300 feet /minute.

At 1905:24, passing altitude 355 feet (QNH 997), the green ALT* was displayed on the ADU again. At 1905:26, the captain said " sigh sigh sigh sigh two hundred" and then ALT SEL was set to 200 feet on the ADU associated to a reversion to basic mode again. At 1905:30, VS HOLD mode is reselected on the ADU with -500 feet /minute

At 1905:35, passing altitude 273 feet (QNH 997), the green ALT* was displayed on the ADU. At 1905:42, the green ALT (ALT HOLD mode) was displayed on the ADU. At 1905:44, the AP was disengaged at 219 feet (QNH 997) and VS HOLD mode is reselected with -100 feet/minute. The heading was changed from 214° to 207° with a maximum bank angle of 10° in 7 sec.

About 1905:51, the aircraft overflew the Missed Approach Point (MAP) at the altitude of 176 feet (QNH 997) where the Minimum Descent Altitude (MDA) is 330 feet and levelled off around 10 seconds then continued to descend.

At 1905:59, Yaw Damper (YD) was disengaged at 192 feet (QNH 997) and the heading was changed from 207° to 188°, starting with left bank angle 10° to 20° then returned to 10° in 10 seconds, The pitch dropped from 0.5° to -9° maximum at the end the turn. At1906:03, the green VOR*

was re-displayed again on ADU with bank angle 19°, heading 197° and altitude 162 feet (QNH 997).

At 1906:11, both pilots called "Go Around" at 72 feet (QNH 997) and both Power Levers were advanced. At 1906:13, unidentified sound was recorded. At 1906:18, both FDR and CVR stopped recording.

1.5 Personnel Information

1.5.1 Flight crew's background and experience

1.5.1.1 Captain

The captain had the nationality of the Republic of China, and served in the Army Aviation Command as a pilot. He joined TNA in July 1992 after he retired from the army. He completed first officer training in December 1992 and served as a first officer in the ATR 42/72 fleet. In October of 1995, he completed ATR 42/72 upgrade training and was promoted as a captain in November 1995. As of the occurrence, he accumulated total flying time of 22,994 hours, within which the ATR 42/72 was 19,069 hours.

The captain held the Air Transport Pilot License (ATPL) issued by the CAA of the Republic of China with Multi-Engine Land rating, type rating in the ATR-72, endorsed with privileges for operation of radiotelephone on board an aircraft with no limitation, and remarked with "English Proficient: ICAO Level 4 Expiry Date 2014-03-23".

1.5.1.2 First Officer

The first officer had the nationality of the Republic of China. He was hired by TNA in July 2011 with no previous airline experience. After the completion of training, he severed as an ATR 42/72 first officer. His total flying time was 2,392 hours as of the occurrence.

The first officer held the Commercial Pilot License (CPL) issued by CAA of the Republic of China with Multi-Engine land rating, type rating in the ATR-72 F/O, endorsed with privileges for operation of radiotelephone on board an aircraft with no limitation, and remarked with "English Proficient: ICAO Level 4 Expiry Date 2015-01-08".

Table 1.5.1-1 Flight crew's Basic Information

Item	Captain	First Officer
Gender	Male	Male
Age as of accident	60	39
Date of hiring in TNA	01 July 1992	01 July 2011
License issued	ATPL – Aeroplane	CPL – Aeroplane
Type Rating Date of Expiry	ATR 72 08 November 2015	ATR 72 F/O 08 January 2017
Medical certificate issued Date of Expiry	First Class 31 August 2014	First Class 31 May 2015
Total flying time	22,994 hrs and 29 min.	2,392 hrs and 55 min.
Total flying time of ATR 42/72	19,069 hrs and 56 min.	2,083 hrs and 55 min.
Total flying time last 12 months	945 hrs and 10 min.	964 hrs and 46 min.
Total flying time last 90 days	278 hrs and 06 min.	264 hrs and 44 min.
Total flying time last 30 days	100 hrs and 59 min.	88 hrs and 55 min.
Total flying time last 7 days	22 hrs and 18 min.	22 hrs and 35 min.
Total flying time last 24 hours	03 hrs and 31 min.	03 hrs and 31 min.
Rest period before occurrence	15 hrs 07 min	15 hrs 07min.

1.5.2 Flight crew training record

1.5.2.1 Captain

Initial training:

The captain conducted his ATR 42/72 initial training at Flight Safety International from 18 September to 28 September 1992, including

academic, and simulator training. He completed the training successfully and a certification was issued by Flight Safety International on 28 September 1992. He continued his training and was qualified as the ATR 42/72 first officer on 06 November 1992; He finished his route training of ATR 42/72 on 12 December 1992 and passed the first officer line check on 14 December 1992.

Upgrade training:

The captain received his captain ground school and simulator training of ATR 42/72 from 16 August 1995 to 22 September 1995 and a certification was issued by the Houston learning center Flight Safety International; He was qualified as a captain on 12 October 1995 and passed the line check on 27 October 1995.

Recurrent training:

The annual recurrent ground school was conducted on 06 March 2014 totally 8 hours, the curriculum include adverse weather operations, terrain awareness, abnormal procedure and aircraft limitations. The latest annual proficiency training to the captain was conducted on 17 March 2014, the result of training shows on the proficiency training records is "satisfactory", the latest proficient check was conducted on 18 March 2014, the result of check shows on the proficiency check records is "pass" and the latest annual proficiency line check was completed on 25 December 2013, the check result shows on the check records is "pass".

1.5.2.2 First Officer

Initial training:

The first officer received his ATR 72 initial training on 18 July 2011. The training curriculum include ground school 326 hours, route observation training 25 hours, simulator training 15 sections, local training 5 hours, line training 3 phase 135 hours. He completed initial training on 8 APR 2012 and line check result shows on the check records is "pass".

Recurrent training:

The annual recurrent ground school was conducted on 09 May 2014 totally 8 hours, the curriculum include adverse weather operations, terrain awareness, abnormal procedure and aircraft limitations. The latest annual proficiency training to the first officer was conducted on 21 APR 2014, the result of training shows on the proficiency training records is "satisfactory", the latest proficient check was conducted on 22 April 2014, the result of check shows on the proficiency check records is "pass" and the latest

annual proficiency line check was completed on 10 April 2014, the check result shows on the check records is “pass”.

1.5.3 Flight crew medical information

1.5.3.1 Captain

The most recent first class medical certificate of captain was issued by CAA on 14 April 2014, with limitations on “Holder shall wear corrective lenses”

1.5.3.2 First Officer

The most recent first class medical certificate of first officer was issued by CAA on 08 May 2014 with no limitations.

1.5.4 Flight crews’ activities within 72 hours before the occurrence

1.5.4.1 Captain

1. 20 July: Reported to Songshan airport at 0640 and carried out scheduled flights of Songshan → Magong→ Songshan → Magong → Kingmen → Magon → Kaohsiung , then had a layover at Kaohsiung after the flight duty ended at 1502.

2. 21 July: Reported to Kaohsiung airport at 1420 and carried out scheduled flights of Kaohsiung → Magong → Kaohsiung → Magong → Kaohsiung → Magong → Kaohsiung, then had the second layover at Kaohsiung after the daily flight duty ended at 2108.

3. 22 July: Reported to Kaohsiung airport at 1440 and carried out scheduled flights of Kaohsiung → Kingmen → Kaohsiung → Magong → Kaohsiung → Magong → Kaohsiung, then had the third layover at Kaohsiung after the daily flight duty ended at 2213.

4. 23 July: Reported to Kaohsiung airport at 1320 and were expected to carry out Kaohsiung → Magong → Kaohsiung → Magong → Songshan → Magong → Songshan flights.

1.5.4.2 First Officer

From 20 July to 23 July, the first officer was assigned to the same flight duty patterns with the captain.

1.6 Airplane Information

1.6.1 Automatic Flight Control System (AFCS)

1.6.1.1 General

The ATR 72 is provided with an automatic flight control system. It achieves:

- Autopilot function and/or yaw damper (AP and/or YD)
- Flight director function (FD)
- Altitude alert

Main components are:

- one computer
- one control panel (Figure 1.6-2)
- one advisory display unit (ADU) (Figure 1.6-3)
- three servo-actuators (one on each axis)

The computer receives data from the two Air Data Computers (ADC), the two Attitude and Heading Reference Systems (AHRS), the two Symbol Generator Unit (SGU), the radio-altimeter, the Global Positioning System (GPS) (if installed) and from some sensors. It generates commands to the flight control actuators and FD bars.

The aircraft is equipped with a digital AUTOPILOT/FLIGHT DIRECTOR with advanced control laws (Figure 1.6-1). Systematic use of AP/FD is highly recommended by ATR in order to:

- Increase the accuracy of guidance and tracking in all weather conditions, from early climb after takeoff down to landing minima.
- Provided increased passenger comfort through smooth and repeatable altitude and heading changes in all atmosphere conditions.
- Reduce crew workload and increase safety.

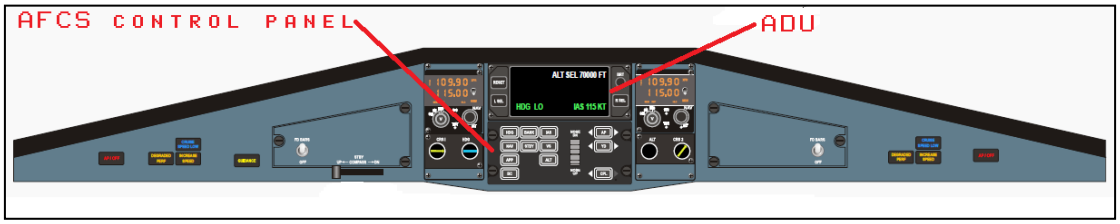


Figure 1.6-1

1.6.1.2 AFCS control panel

AFCS control panel (Figure 1.6-2) is used to perform the mode selections as follows:

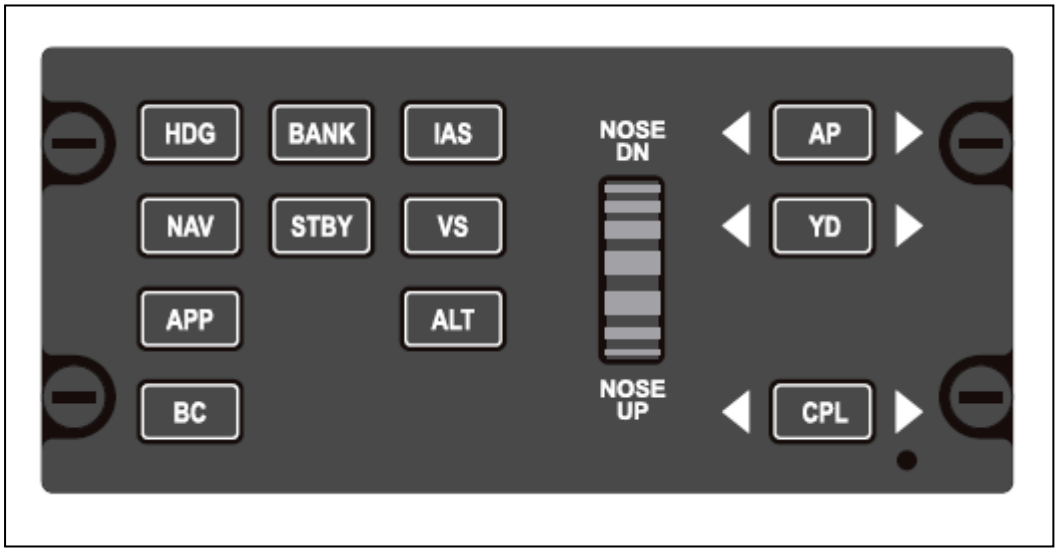


Figure 1.6-2

- AP push button (pb):

  Action on the push button engages autopilot and yaw damper functions simultaneously. All four associate arrows illuminate white. A repeat action on the push button disengages only autopilot function.

- YD pb :

  Action on the pb engages the yaw damper function. Both associate arrows illuminate white. A repeat action on the push button disengages yaw damper function (and the autopilot if engaged).

- CPL pb

  Enables selection of the panel (CAPT or FO) to be coupled to the AP/FD computer. At power up, selected side is CAPT side.

- Pitch Wheel (PW)

  Operation of the pitch wheel when the system is flying VS, IAS will resynchronize the air data command reference (or pitch reference) without disengaging the mode. The pitch wheel is inhibited in GS, ALT SEL CAPTURE and ALT HOLD modes.

- Vertical modes pbs:

Enables selection of vertical modes : IAS HOLD, VS HOLD, ALT HOLD.

- Lateral modes pbs :

  Enables selection of lateral modes : HDG SEL, NAV (VOR, LOC, LNAV), APP (ILS), BC.

- BANK pb :

  Permits selection of the bank angle limit, in HDG SEL mode only. Alternate action on the pb causes alternate selection of a high bank angle limit (27°) and a low bank limit (15°), power up state is high bank limit.

- STBY pb

  Cancels all FD modes (both armed and active). When AP is engaged, resets to basic modes.

Mode selection is achieved by acting on the corresponding push button on the AFCS control panel except for ALT SEL and GO AROUND modes.

Simultaneously armed modes are limited to one lateral mode and two vertical modes. Therefore vertical armed modes are working in the following priority sequence:

1. ILS GS ARMED
2. ALT SEL ARMED

Climb or descent action must be done with entire following sequence:

1. Adjust ALT SEL
2. Select and adjust vertical mode; usually IAS for climb and VS for descent[3] .
3. Adjust power as required

[3] According to ATR FCTM, IAS mode must be used during climb for stall protection. VS mode must be used during descent, except in emergency descent and drift down for which IAS mode is used. The basic pitch mode may be used in accordance with current operator's policy.

4. Change altimeter setting and crosscheck
5. Adjust speed bug.

NAV (VOR, LOC and LNAV) and APP modes must be associated with High Bank speeds.

1.6.1.3 Advisory Display Unit (ADU)

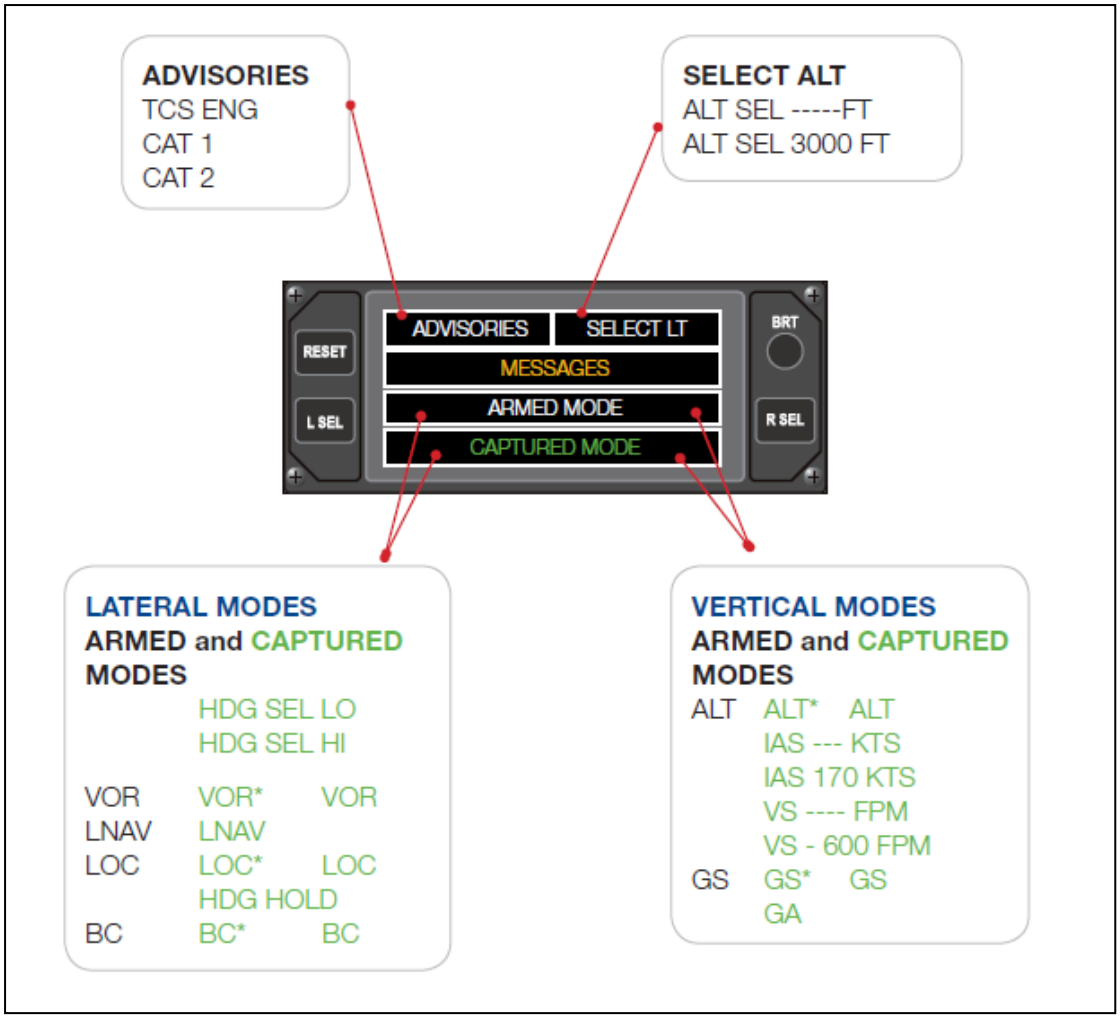


Figure 1.6-3

1.6.2 Weight and Balance information

The actual takeoff weight of this airplane was 46,235 lb. and was loaded within weight and Center of Gravity (CG) limits. The center of gravity of take-off was located at 29.2% MAC and was within the certified limitations between 19.7% and 37% Mean Aerodynamics Chord (MAC). The center of gravity envelope of ATR72 is shown in Figure 1.6-4. Table 1.6-1 shows the weight and balance data.

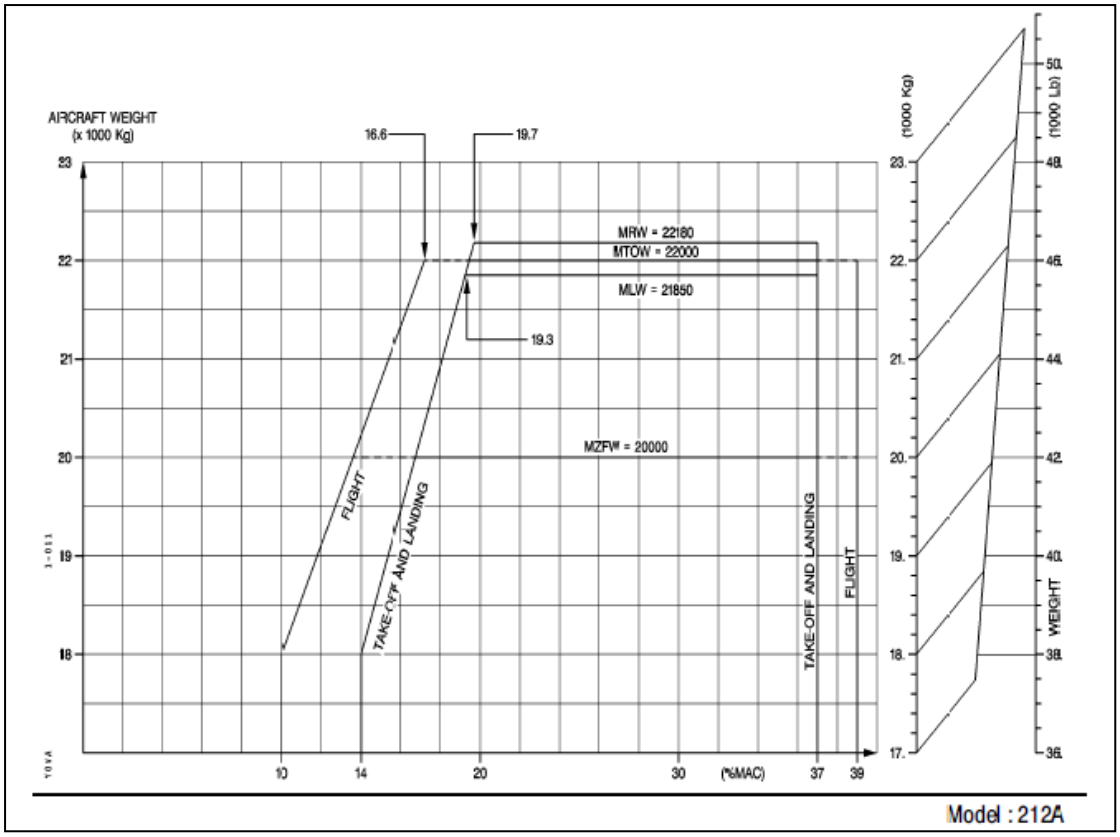


Figure 1.6-4　The center of gravity envelope of ATR72。

Table1.6-1 weight and balance data

unit：lbs

Max. zero fuel weight	44,092
Actual zero fuel weight	41,294
Max. takeoff weight	48,501
Actual takeoff weight	46,235
Take off fuel	4,941
Estimated trip fuel	800
Max. landing weight	48,171
Estimated landing weight	45,435
Takeoff MAC	29.2%
MAC: Mean Aerodynamics Chord	

1.16 Tests and Research

1.16.1 ATR manufacture simulator test

GE 220 (2 flights before occurrence flight GE222) from Kaohsiung to Magong was operated by the same flight crews of GE222. The FDR of GE220 reveals EGPWS alerts was triggered during VOR RWY20 approach at approximate 1.6 Nautical Miles(NM) to MKG VOR. GE 222 FDR/CVR did not show any activation of EGPWS alert. The investigation team like to find out which EGPWS alerts were triggered in GE 220 flight and why no EGPWS alerts were triggered in GE 222. The investigation team also likes to understand GE 222 performance and aircraft behavior under different conditions.

Three simulator sessions were conducted at ATR training center, Toulouse, France to study in the following sequence:

- EGPWS alerts of GE 220
- No EGPWS alert of GE 222
- Stabilized power settings during approach
- AFCS and FD behavior when approaching and passing MKG VOR
- Aircraft behavior after AP disconnected
- Aircraft behavior after YD disengaged
- Rudder force required to disengage YD
- Control column force required to reach 9° pitch down
- Descent rate with 9° pitch down
- AFCS basic mode

※**First simulator session** (Attachment 1-1 EGPWS simulator session video file)

0730 – 0930 local time, 05 November

Attendees:

ASC Thomas Wang, Steven Su, Michael Guan, Cobra Chang, Norman Pin

BEA Yann Torres, Henri Denis

ATR Jerome Bonetto, Jerome Pfeiffer, Claude Noudeau, Nicolas Alix

This session was set up to study EGPWS alerts of GE 220 and GE 222.

GE 220 EGPWS test flight

Two scenarios were used in this part. There were only small differences between ATR GE 220 EGPWS scenario (Figure 1.16-1)and ASC GE 220 EGPWS scenario (Figure 1.16-2)such as weight unit, QNH, altimeter setting and descent profile. ASC GE 220 EGPWS scenario was duplicated according to GE 220 FDR and real time weather.

"Too Low Terrain", "Terrain Ahead" and "Terrain Ahead Pull-Up" EGPWS alerts were triggered in both scenarios. The alerts were triggered at 1.8 NM to MKG VOR in ATR scenario and 1.6 NM to MKG VOR in ASC scenario.

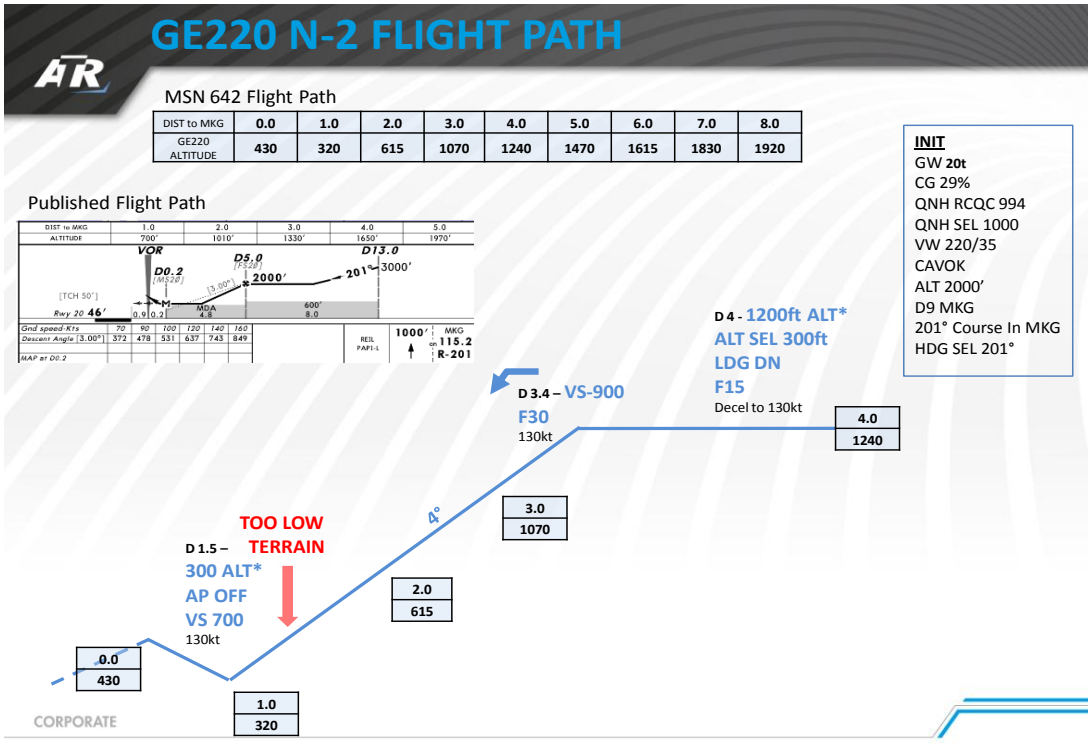


Figure 1.16-1 ATR GE 220 EGPWS scenario

GE220 EGPWS Test Flight Plan

Weight & Balance

GE 220	
ZFW	41987 lbs
FUEL	4941 lbs
GW	46927 lbs
TOMAC	28.0
TO TRIM	1.0 Nose Up

Location	MKG VOR(115.2) 021 Radial, 9 NM
Gross Weight	46587 lbs, ZFW 41987 lbs, Fuel 4610 lbs
Weather	Wind 315/39, TAT 28°C, QNH 993 mb
Altitude	700 ft PAlt
IAS	125 kts (VmHB 108 kts)

Aircraft Set Up- Normal Flight Deck Set Up

Power plant	
PWR MGT	TO
CL	AUTO
ENG 1 TQ	~30%
ENG 2 TQ	~30%

Auto Flight	
AP	Engaged
YD	ON
CPL	L

AFCS	
NAV	VOR green
ALT SEL	300 ft
VS Mode	Engaged
Selected VS	-700 ft/min
EFIS	FULL

Configuration	
LG	Down
Flap	30
Pitch Trim	-0.1
Yaw Trim	-1.2
Roll Trim	2

Scenario
GE2220 Altimeter Setting was 999 mb. Aircraft's configuration change followed ATR scenario.

Figure 1.16-2 ASC GE 220 EGPWS scenario

GE 222 EGPWS test flight

No EGPWS alert was triggered either in ATR GE 222 EGPWS scenario (Figure 1.16-3) or ASC GE 222 Approach Profile Study scenario (Figure 1.16-4).

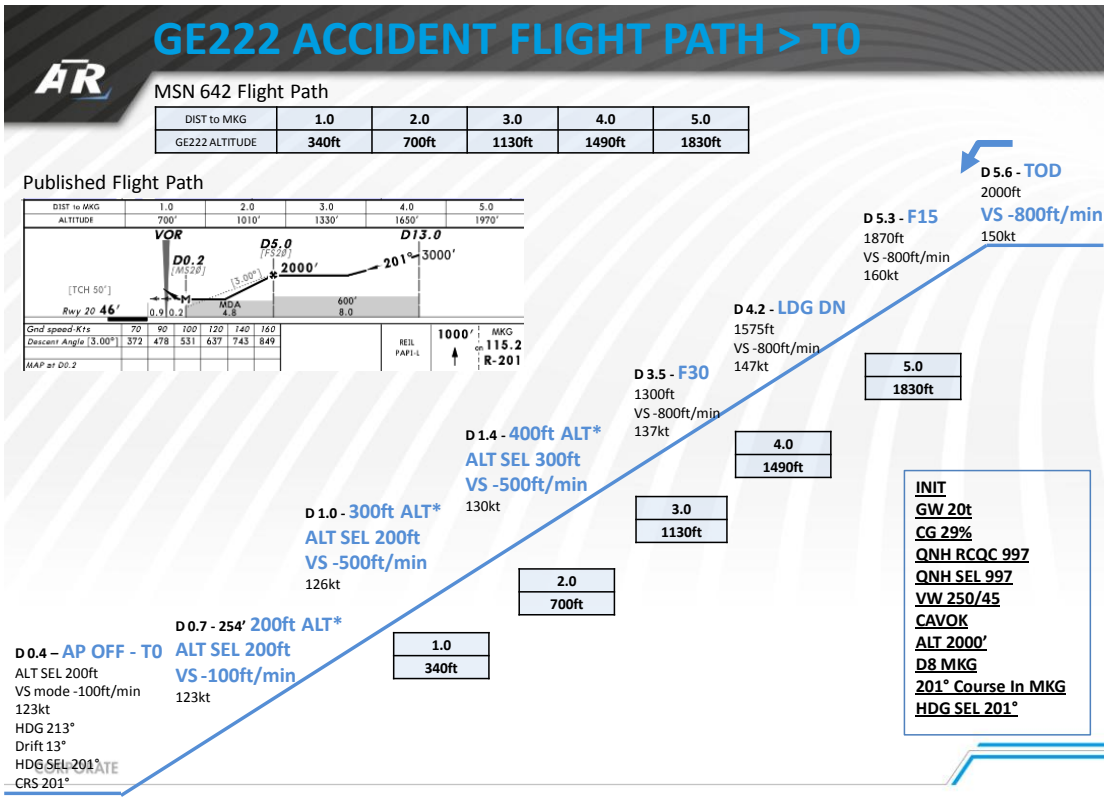


Figure1.16.3

※**Second simulator session** (Attachment 1-2 GE 222 performance simulator session video file)

0730 – 1215 local time, 06 November

Attendees:

ASC Norman Pin

BEA Yann Torres, Henri Denis

ATR Jerome Bonetto, Jerome Pfeiffer, Claude Noudeau, Nicolas Alix

This session was dedicated to study GE 222 performance and aircraft behavior under different conditions. The simulator was set up according to ASC GE 222 Approach Profile Study Flight Plan(Figure 1.16-4)which is based on GE 222 FDR and real time weather. GE 222 final approach profile was executed according ATR GE 222 maneuver guide(Figure 1.16-5).

GE222 Approach Profile Study Flight Plan

Weight & Balance

GE 222	
ZFW	41294 lbs
FUEL	4941 lbs
GW	46235 lbs
TOMAC	29.2
TO TRIM	0.8 Nose Up

Location	MKG VOR(115.2) 021 Radial, 8 NM
Gross Weight	45424 lbs, ZFW 41294 lbs, Fuel 4130 lbs (RH tank>LH tank=13Lbs)
Weather	Wind 250/35, TAT 21°C, QNH 997 mb
Altitude	2000 ft PAlt
IAS	125 kts (VmHB 107 kts)

Aircraft Set Up- Normal Flight Deck Set Up

Power plant	
PWR MGT	TO
CL	AUTO
ENG 1 TQ	~30%
ENG 2 TQ	~30%

Auto Flight	
AP	Engaged
YD	ON
CPL	L

AFCAS	
NAV	VOR green
ALT SEL	400 ft
VS Mode	Engaged
Selected VS	-700 ft/min
EFIS	FULL

Configuration	
LG	Down
Flap	30
Pitch Trim	0
Yaw Trim	1.8
Roll Trim	2.4

.

Final approach profile

Descent from 3.4 NM MKG 021 Radial at 1200 ft with 700 ft/min descent rate and 125 IAS. ALT was displayed on ADU at approximate 460 ft Palt, 2 sec later ALT SEL was reset to 300 ft and VS Mode was reselected with -500 ft/min, ALT* was displayed again on ADU at approximate 350 ft Palt, 3 sec later ALT SEL was reset to 200 ft and VS Mode was reselected with -500 ft/min, ALT* was displayed again on ADU at approximate 270 ft Palt and ALT green was displayed on ADU at approximate 200 ft Palt. At 0.5 NM to MKG VOR, autopilot was disengaged and VS Mode was reselected with -100 ft/min, The heading was changed from 214° to 207° with maximum bank angle 10° in 7 sec, maintain heading 207° and altitude 200 ft for 7 sec, over MKG VOR Yaw Damper was OFF, The heading was changed from 207° to 188° with bank angle 10°-20°-10° in 12 sec, The pitch dropped to maximum -9°during rollout with bank angle 12°.*
VOR was re-displayed again on ADU during the turn with bank angle 19°, heading 195° and altitude 150 ft PAlt.*

Figure 1.16-4 ASC GE 222 Approach Profile Study Flight Plan

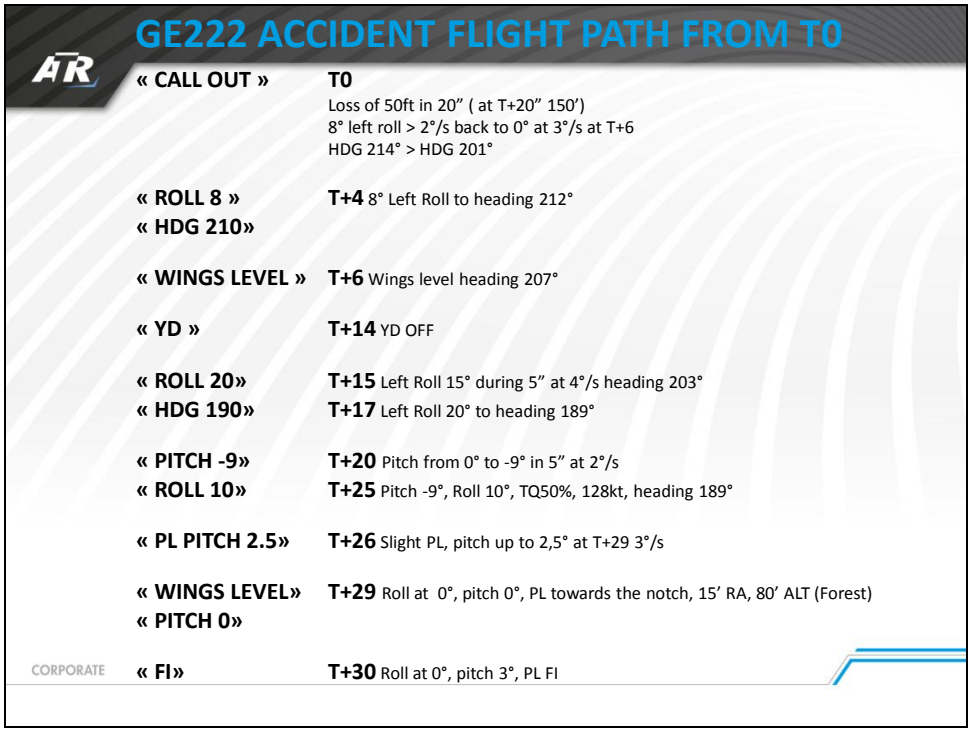


Figure 1.16-5 ATR GE 222 maneuver guide

Findings:

- 28 % TQ(Torque) required on both engines to stabilized descent with 700 feet/minute descent rate and 125 knots Indicated Air Speed.
- 43 % TQ(Torque) required on both engines to stabilized descent with 100 feet/minute descent rate and 125 knots Indicated Air Speed.
- Aircraft remained on course, Course deviation bar on EHSI (Electronic Horizontal Situation Indicator) remained center and the green VOR changed to green VOR* on ADU when passed MKG VOR either on 200 feet or 500 feet altitude.
- Aircraft attitude did not change after AP disconnected.
- Aircraft banked 9° left after YD disengaged with minor left bank angle (1°or 2°).
- Aircraft banked 11° right after YD disengaged with minor right bank angle (1°or 2°).
- 30 daN rudder pedal force required to disengaged YD
- 15 daN control column push force required to reach 9° pitch down
- 900 feet/minute showed on Vertical Speed Indicators with 9° pitch down

- The green VOR unchanged after end of ATR GE 222 maneuver
- The white VOR armed disappeared and HDG mode remained displayed on ADU, after changed from V/L push button selected to RNV push button selected on EFIS control panel.

※**Third simulator session** (Attachment 1-3 GE 222 performance with turbulence simulator session video file)

0730 – 0930 local time, 07 November

Attendees:

ASC Norman Pin, Cobra Chang

BEA Thierry Loo

ATR Jerome Bonetto, Jerome Pfeiffer, Claude Noudeau,

This session was dedicated to study GE 222 performance and aircraft behavior under different conditions in turbulence. The simulator set up was the same as second simulator session's set up except 50% intensity of turbulence was added. The results are the same as second simulator session.

1.16.2 TNA simulator training observation

ASC flight operations team had conducted the observation of 3 TNA simulator sessions at Bangkok Airways training center, Thailand. Each session was 4 hours and split evenly between 2 pilots. Last transition training lesson 7 was observed on 12 October 2014 with two first officer trainees. The transition check was observed on 14 October 2014 with same flight crews of transition training. The proficiency training was observed on 15 October 2014 with a captain and first officer. Appendix 1-1 is the syllabus of the transition training, transition check and proficiency training. (Attachment 1-4 TNA simulator training observation video file) The Appendix 1-2 is the observations of these 3 simulator sessions.

1.16.3 Line operation observation

The purposes of the line operation observation were to understand flightcrew performance of ATR 72-500 fleet and stability of MKG VOR during RCQC VOR RWY20 APP.

Total 24 flights (2 Hualien, 8 Magong 2 Kinmen) were observed and all were turn around flight back to Songshan.

Table1.16-1 History of TNA line observation flights

	Date	Flight Number	To/From
1	04, August, 2014	GE017/GE020	TSA-HUN-TSA
2	04, August, 2014	GE2351/GE238	TSA-KNH-TSA
3	04, August, 2014	GE505/GE506	TSA-MZG-TSA
4	08, August, 2014	GE513/GE514	TSA-MZG-TSA
5	08, August, 2014	GE505/GE506	TSA-MZG-TSA
6	08, August, 2014	GE5055/GE5084(600)	TSA-MZG-TSA
7	20, August, 2014	GE5055/GE506	TSA-MZG-TSA
8	22, August, 2014	GE5055/GE5056	TSA-MZG-TSA
9	27, August, 2014	GE505/GE506	TSA-MZG-TSA
10	28, August, 2014	GE017/GE020	TSA-HUN-TSA
11	29, August, 2014	GE0233/GE2322	TSA-KNH-TSA
12	05, September, 2014	GE505/GE506	TSA-MZG-TSA

The Appendix 1-3 is the observations of these 24 flights.

1.16.4 Aids to Navigation

1.16.4.1 RCQC VOR RWY20 flight inspection

A RCQC VOR RWY20 flight inspection was requested to be conducted on 23 July 2013 by Air Traffic Services Division for RCQC VOR RWY20 instrument procedure revision.

The result of RCQC VOR RWY20 flight inspection (Appendix 1-4) was “Unrestricted”.

1.16.4.2 RCQC VOR RWY20 special flight inspection

As per ASC’s request to validate the signal stability for approach, post-accident MKG VOR flight checks (Appendix 1-5) were conducted by CAA in accordance with Magong airport VOR RWY20 instrument flight procedures on 30 July 2014. The MKG VOR is a DVOR, the test procedure is described as follows:

The first test: The course of the VOR approach procedure was set as the NAV SOURCE to fly inbound with R-021 radial, at an altitude of 3, 000 feet, 10 nautical miles from MKG VOR, and flew over the VOR at an altitude of 330 feet.

The second test: The course of the VOR approach procedure was set as the NAV SOURCE to fly inbound with R-021 radial, at an altitude of 3, 000 feet, 10 nautical miles from MKG VOR, and flew over the VOR at an altitude of 200 feet.

The third test: The course of the VOR approach procedure was set as the NAV SOURCE to fly inbound with R-021 radial, at an altitude of 3, 000 feet, 10 nautical miles from MKG VOR, and landed at the RCQC.

As per ASC's request, the flight check results are described as follows:

Test Item	First Test	Second Test	Third Test
Where did CDI begin to shift	1.5 NM	1.4 NM	0.1 NM
How many dots of deviation were indicated on the HSI	2.0 dots maximum (around 0.2 DME)	1.9 dots maximum (around 0.2 DME)	2.0 dots maximum (around 0.1 DME)
Where did the TO/FROM indication of the VOR begin	0.5 NM	0.4 NM	0.1 NM

Note: In the meeting with the flight check group of flight standards division in the CAA, they stated the distance described in the above table meant to be "before" passing MKG VOR.

1.17 Organizational and Management Information

1.17.1 Training Department

Figure 1.17-1 is the organization chart of TNA Flight Operation Division.

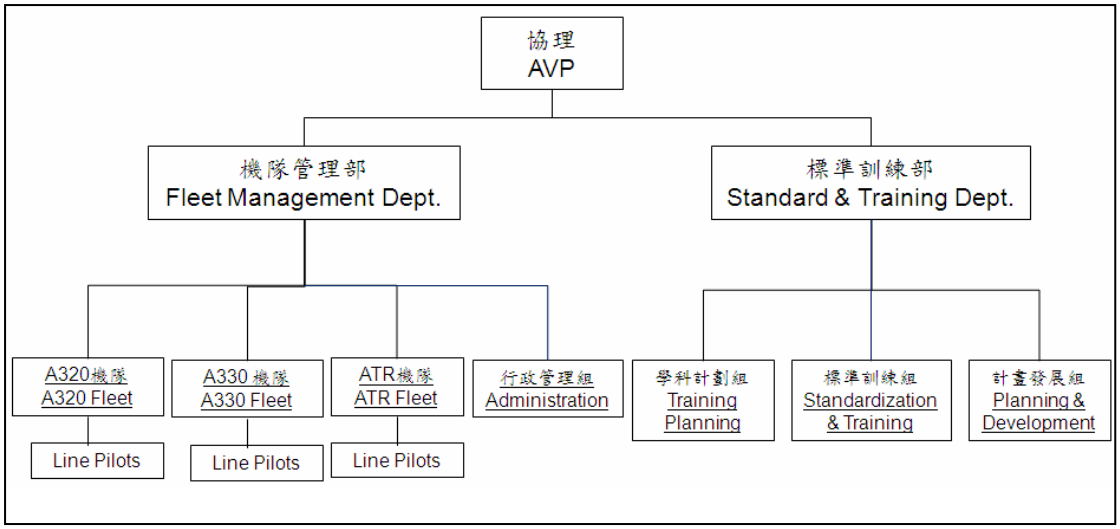


Figure 1.17-1 Organization chart of TNA Flight Operation Division

The flight training and check in TNA was handled by the Standard and Training department which oversaw training involving flight crew. In particular, this department provides the following trainings and flight checks for all fleets, including the ATR fleet:

(a) Aircraft Type Training
(b) Ground School
(c) Initial Training
(d) Recurrent Training
(e) Transition
(f) Upgrade Training
(g) Instructor and Examiner Training
(h) Ab-initio Training
(i) Re-Qualification Training
(j) Cross Crew Qualification (AIRBUS) or Difference (ATR) Training

In addition to the aforementioned trainings, the training department also provided Dangerous Goods training and special operations training, such as RVSM (Reduced Vertical Separation Minimum), PBN (Performance Based Navigation), ETOPS (Extended Range Two Engine Operations), LVO (Low Visibility Operations), Cold Weather Operations, High Elevation Airport Operations.

If suitable first officers are selected to be upgraded to captains, the standard and training department would provide the upgrade training. Pilots who hold the same aircraft type rating will be offer a transfer training after joining TNA.

For those who join TNA with no previous flight experience and are airline pilot candidates will receive the ab-initio training which requires a minimum 250 hours total fly time, or 190 hours when undergo special training program approved by CAA. The standard and training department has been delegated by CAA to nominate and trainee designated examiners (DE) of aircraft type to conduct type rating check on behalf of CAA.

1.17.1.1 Aircraft Type Rating Training:

The normal aircraft type training comprises of the following:

(a) Ground School: may be conducted by E-learning or in the class room for teaching aircraft systems, aircraft performance and safety and emergency procedures.

(b) Line Observation: 25 hours minimum, must be completed before commencing initial operating experience (IOE).

(c) Simulator training: covering normal and non-normal procedures, including wind shear, CFIT, TCAS, and Unusual Attitude Recovery. This training of 15 sessions was conducted in fixed based and full flight simulator.

(d) Local Training: two hours of simulators training will be given before training in actual aircraft. The local training includes two training flights and one check ride.

(e) IOE: contains three different phases. The first phase focus on the PM duties, the second phase focused on the PF duties, and the last phase emphasizes on total performance.

(f) Trainees will be required to pass a final line check prior to be a fully qualified line pilots.

1.17.1.2 Recurrent Training:

The department also provides a recurrent training program for pilots every 6 months or annually. The program consists of ground school and simulator sessions, one of which must include one LOFT scenario, and the ground school shall not be less than 20 hours each year. Within the twelve calendar months valid period of type rating certificate, two recurrent trainings and checks shall be conducted. The training shall be completed before the check, and the interval between two checks shall be within four to eight calendar months.

1.17.1.3 Conduct of practical tests

From the year of 2011 till 2013, only one pilot had failed a proficiency check in the ATR 72-500 fleet in 2011. Other than that, all other pilots passed the type rating, proficiency and line checks in these three years.

1.18 Additional Information

1.18.1 Aircraft Operating Procedures

TransAsia Airways provided procedural guidance to its flight crews in several documents (TNA FOM, TNA SOP, TNA FCTM, ATR FCOM). Flight crew procedures specific to the ATR72 were found in the TNA ATR Standard Operation Procedure (SOP) (Attachment 1-7) and TNA ATR Flight Crew Training Manual (FCTM)(Attachment 1-8). The TNA Flight Operations Manual (FOM) (Attachment 1-9) established general procedures and provided instructions and guidance for use by flight operations personnel in the performance of their duties. Additional guidance was found in the ATR72 Flight Crew Operating Manual (FCOM) (Attachment 1-10), which was prepared by ATR and included operating limitations, procedures, performance, and systems information. With the FCOM, ATR also provided a ATR72 QRH that listed normal, emergency, following failure procedures in a checklist format. Flight crews were expected to follow SOP guidance where it was more restrictive than other guidance, such as that in the ATR FCOM.

ATR also published FCTM (Attachment 1-11) which was not used by TNA ATR FCTM is a tool to the ATR Standard Operation Procedures. This manual is a comprehensive document that efficiently complements FCOM procedures. In the Normal Procedures part, procedures are presented with detailed task sharing and include standard call outs. Additional procedures relating to specific operations and to equipments uses are part of this manual. In the Emergency & Abnormal Procedures part, the general management of abnormal situations is explained. Then, a detailed presentation of the procedures to apply per specific situation is made.

1.18.2 Crew Resource Management

TNA has adopted the following definition of crew resource management (CRM): CRM consists of all the knowledge, skills and roles used to most effectively direct, control and coordinate all available resources towards safe and efficient operations.

Accordingly, the company has established the following CRM policy:

1. CRM ability and a facility for teamwork will be criteria for flight crewmember selection.
2. CRM principles and practices will be fully integrated into all aspects of flight operations training.
3. All crewmembers will share the responsibility for establishing an environment of trust and mutual commitment prior to each flight, encouraging his fellow crewmember(s) to speak out and to accept mutual responsibility for the safety and well-being of the passengers and equipment entrusted to them. "What's right, not who's right" will be the motto of TNA crews.
4. Each flight crewmember will be responsible for notifying the pilot in command if any condition or circumstance exists that could endanger the aircraft or impair the performance of any crewmember.

According to TNA FTMM (Attachment 1-12), CRM ground and simulator training are included in every initial and transition training. Recurrent training conducted CRM ground training at least every 3 years and simulator CRM training annually. The CRM instructor has to receive Human Performance and Human Factor training.

TNA flight crew, cabin crew and dispatchers shall complete a CRM joint course as defined in Flight Training Management Manual or other related manuals.

1.18.3 Aerodrome Operating Minimum

According to ICAO Annex 6 Operation of Aircraft, the definition of Aerodrome Operation Minima is:

The limits of usability of an aerodrome for:

a) take-off, expressed in terms of runway visual range and/or visibility and, if necessary, cloud conditions;
b) landing in precision approach and landing operations, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H) as appropriate to the category of the operation;
c) landing in approach and landing operations with vertical guidance, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H); and
d) landing in non-precision approach and landing operations, expressed in terms of visibility and/or runway visual range, minimum descent

altitude/height (MDA/H) and, if necessary, cloud conditions.

ICAO Doc 8168 Procedures for Air Navigation Services – Aircraft Operation, Volume I, Flight Procedures, Section 4. Arrival and approach procedures, Chapter 1. General criteria for arrival and approach procedures, 1.6 Factors affecting operational minima states:

In general, minima are developed by adding the effect of a number of operational factors to OCA/H to produce, in the case of precision approaches, decision altitude (DA) or decision height (DH) and, in the case of non-precision approaches, minimum descent altitude (MDA) or minimum descent height (MDH). The general operational factors to be considered are specified in Annex 6. The detailed criteria and methods for determining operating minima are currently under development for this document. The relationship of OCA/H to operating minima (landing) is shown in Figures I-4-1-2, I-4-1-3 and I-4-1-4. (Figures18-1, 18-2 and 18-3)

In order to meet ICAO Universal Safety Oversight Audit Program (USOAP) standard, CAA decided to convert Instrument Flight Procedures based on FAA TERPS criteria to ICAO PANS-OPS criteria in 2009. Three meetings were also called to discuss this conversion on 12 November 2009 (2 meetings) and 25 January 2010 respectively (Appendix 1-6). CAA had also issued Aeronautical Information Circular (AIC) 02/10 (Appendix 1-7) to describe this conversion on 13 August 2010.

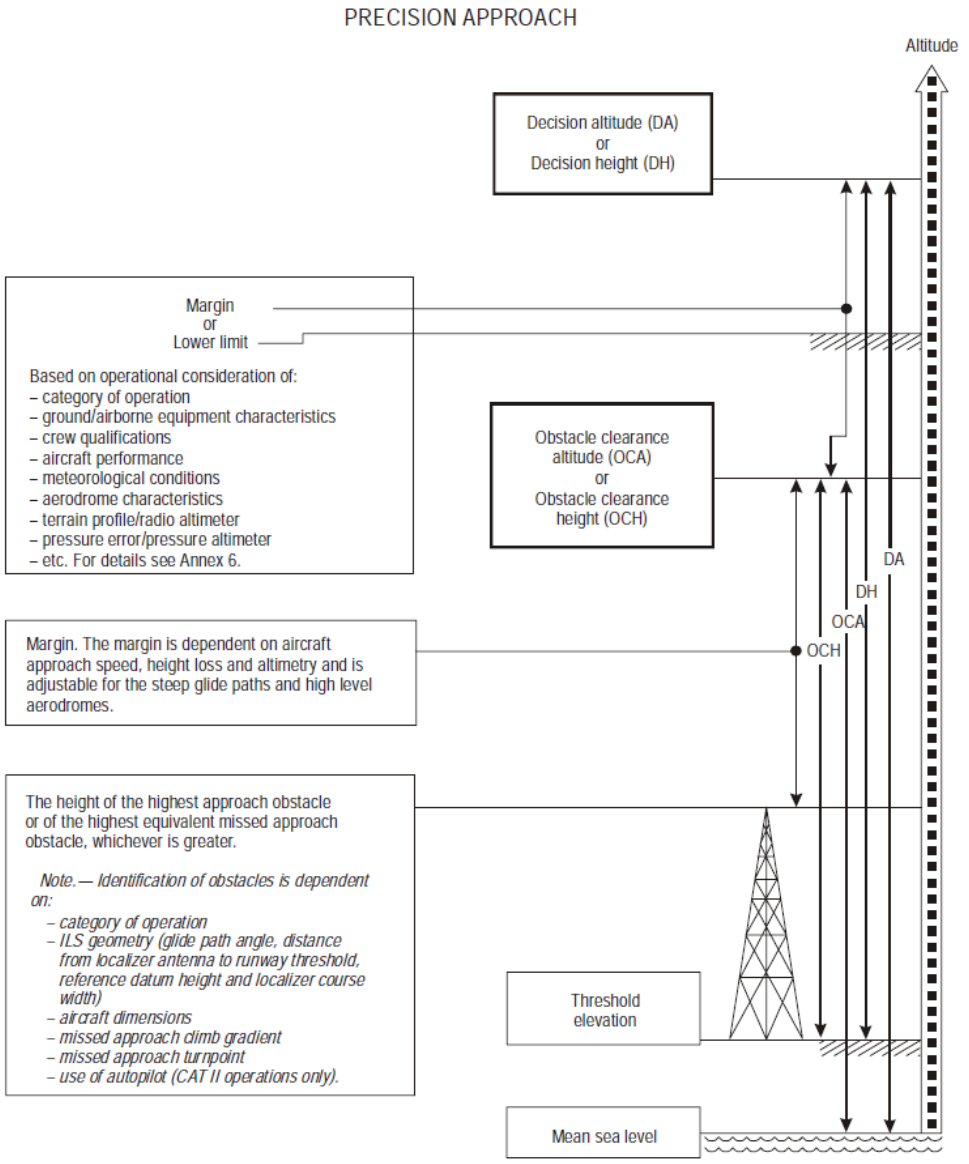


Figure I-4-1-2. Relationship of obstacle clearance altitude/height (OCA/H) to decision altitude/height (DA/H) for precision approaches

Figures18-1 Precision Approach DA

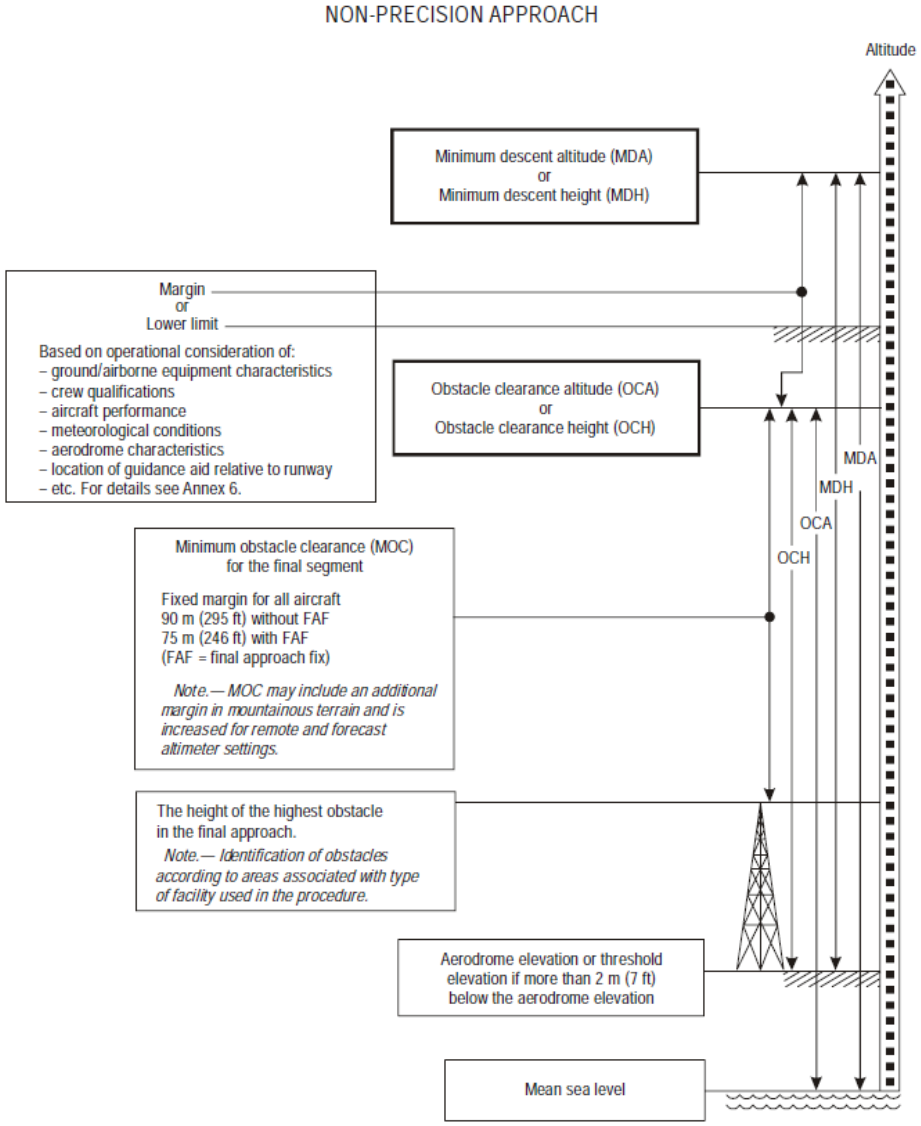
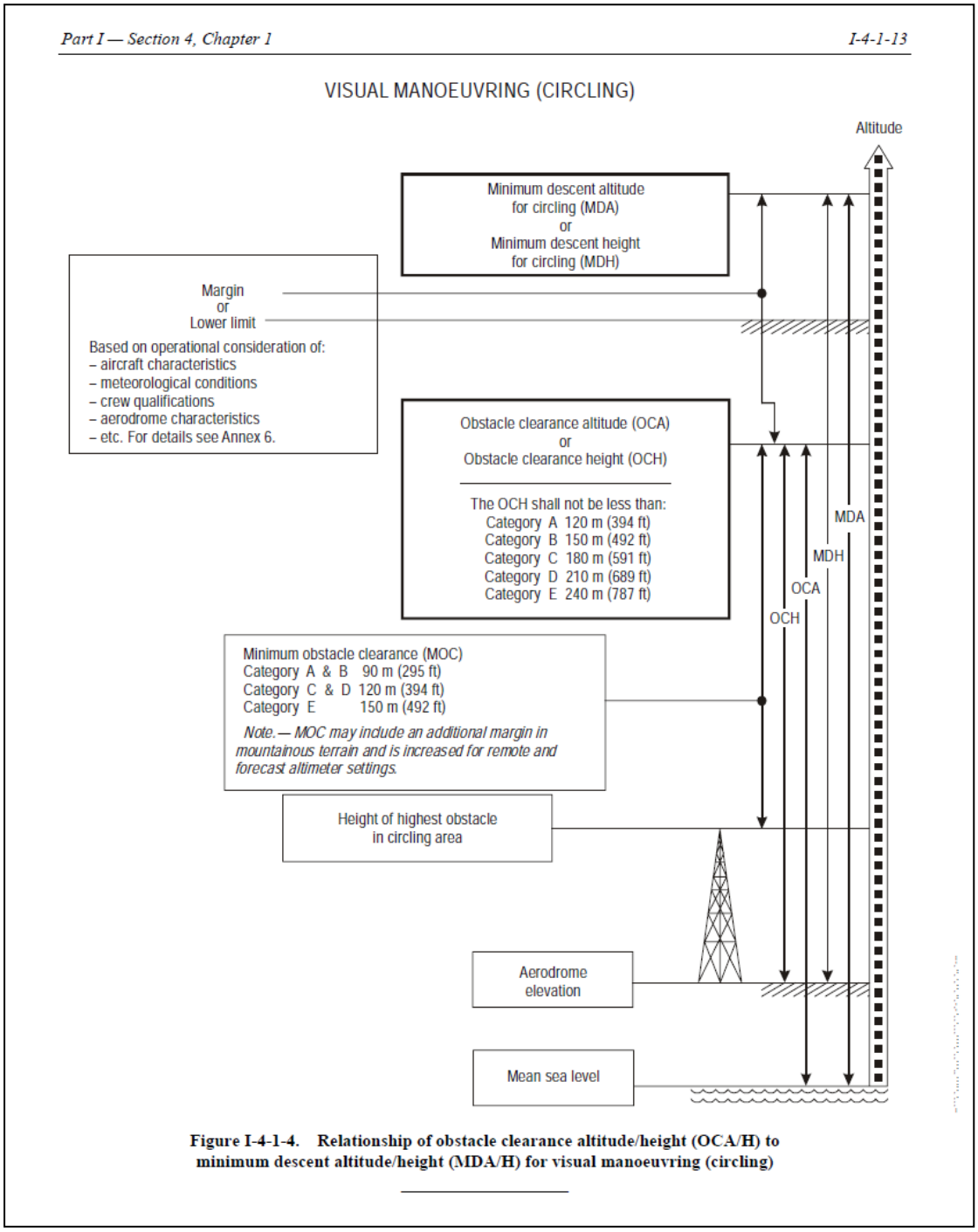


Figure I-4-1-3. Relationship of obstacle clearance altitude/height (OCA/H) to minimum descent altitude/height (MDA/H) for non-precision approaches (example with a controlling obstacle in the final approach)

Figures18-2 Non Precision Approach MDA



Figures18-3 Circling MDA

1.18.4 RCQC VOR RWY20 aeronautical chart

TNA provided Jeppesen charts to their flight crew. Figure 1.18-4 is the Jeppesen RCQC VOR RWY20 chart dated 20 JUN 2014. Figure 1.18-5 is CAA AIP RCQC VOR RWY20 chart dated 26 JUN 2014.

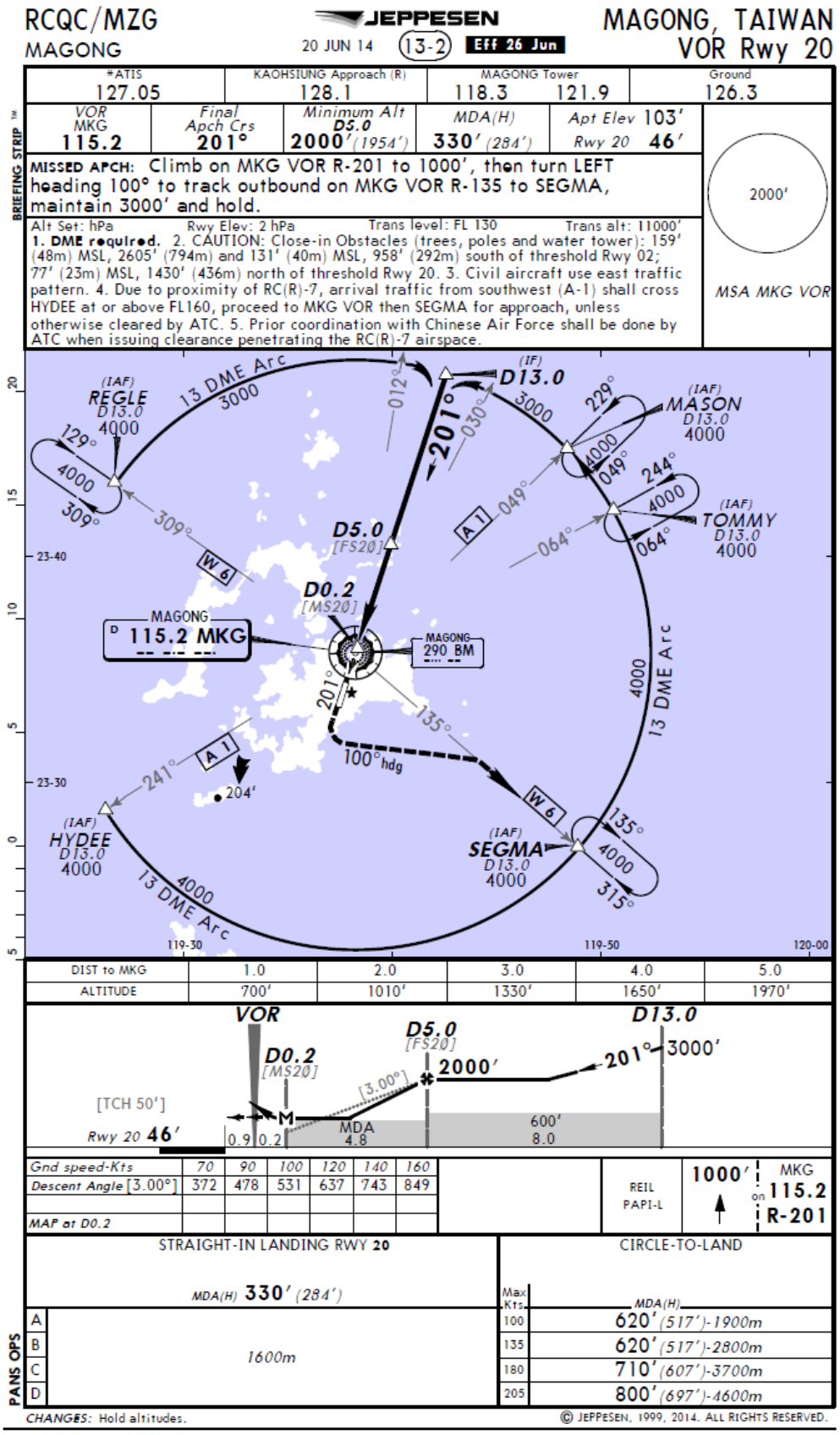


Figure 1.18-4 Jeppesen RCQC VOR RWY20 chart

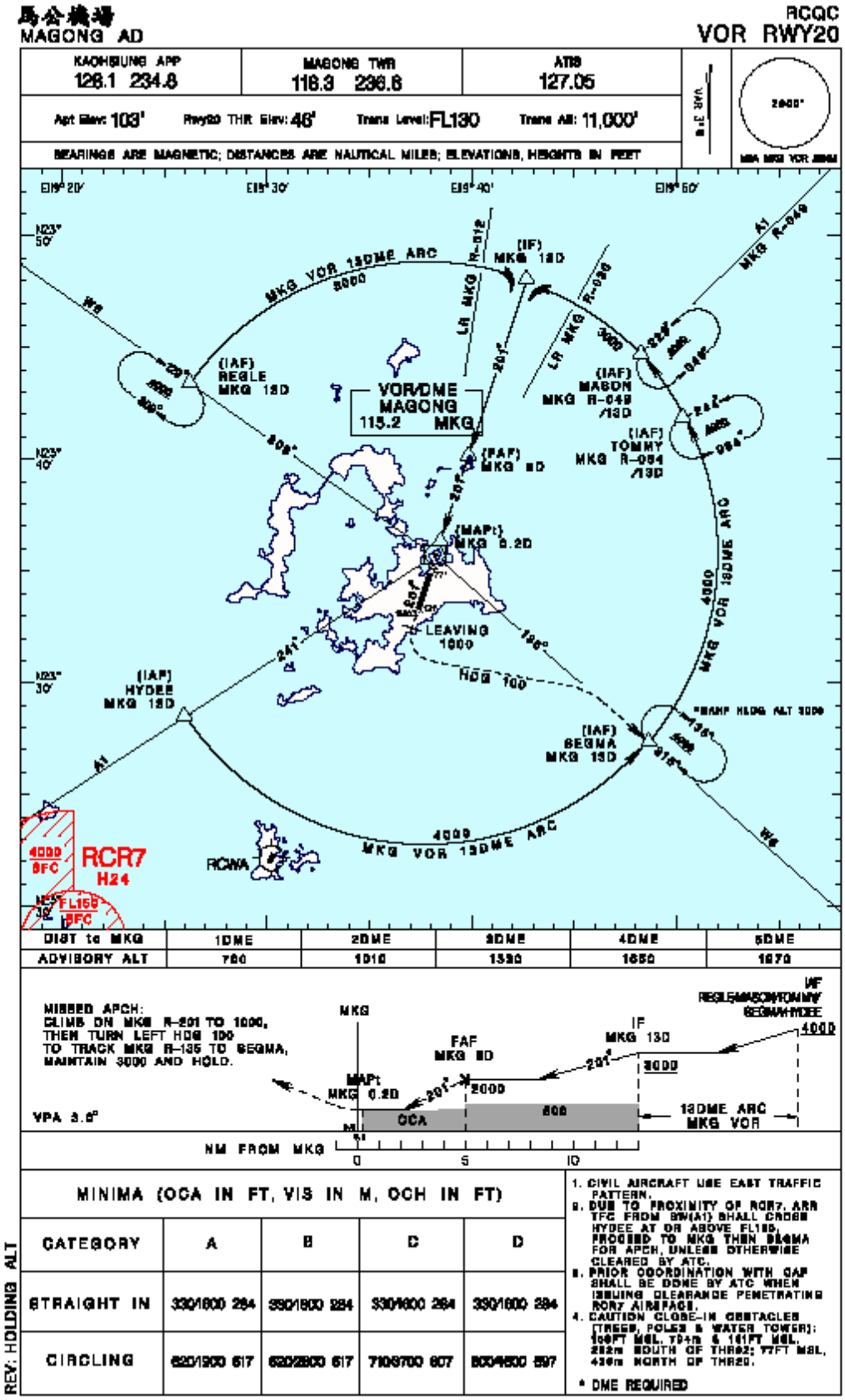


Figure 1.18-5 CAA RCQC VOR RWY20 chart

1.18.5 Summary of interview

1.18.5.1 UNI Airways Flight Crew

The interviewee stated that he conducted B7 647 flight to Magong before the occurrence. In accordance with the onboard weather radar, the weather was really bad, he was told to hold in the air about 40 minutes, the aircraft was in the cloud most of the time, he requested the ILS 02 approach during holding for ATIS reported the weather condition above landing minimum, but was not approved by controller. On their approach to Magong airport, the runway became in sight when they were descending through 1,000 ft. Even their flight was in turbulent air during the approach, no downdraft had been encountered at all. The visibility suddenly deteriorated after landing, by the time they reached their parking bay 2 after vacating the runway, severe thunderstorm began pouring heavy rain shower and made disembarkation of passengers impossible. They had to wait for a while until they could actually disembark all passengers onboard. By the time the disembarkation was almost complete, they saw fire engines standing by near the runway, but they was not aware of the occurrence of GE222 at that moment.

He felt the weather report at Mogong airport is accurate enough, otherwise pilot would write the unsatisfied report. He also stated the VOR signal is good except it may temporarily failure but the indication was accurate. He did not think that the pilot mistook the village lighting east of the runway as the runway light while conducting VOR approach runway 20.

1.18.5.2 CAA Official

The flight operations section manager joined CAA on October 8th, 2004, and took the current position on March 30th, 2008. He described that he was in charge of the flight check group of navaids, light sport aircraft, and flight operations, etc. The flight operations section manager mentioned he was not trained to operate the flight check aircraft, he only supervised the administration flow of the flight check operations and observed couple flights. Long before being promoted as a division director, the former director of flight standards division had been the actual flight check group leader until his retirement on the 1st of July, 2014. Thereafter the current group leader was another CAA inspector.

The flight operations section manager also stated that, the Air Traffic Services division was in charge of handling meetings for the transition of approach chart design from TERPS to PANSOPS specifications, however, he could not remember the AIR TRAFFIC SERVISES division held how many meetings on this issue or who in the flight operations section

attended these meetings, but it was for sure inspectors in the flight check group were sent to attend such meetings. The flight operations section manager indicated that the decision to use PANSOPS specifications for the approach chart design was beyond the terms of reference of his section or the flight standards division.

While being asked to explain why the approach charts in the AIP only showed the OCA (H) instead of DA (H) / MDA(H) on the Jeppessen ones, the section manager answered that, the ICAO Annex 6 had defined that, "the State of the Operator shall require that the operator establish aerodrome operating minima for each aerodrome". Thereby CAA had made the article 28 in the AOR which required operators to meet the standards of such. The section manager emphasized that the FAA and ICAO format OPSPECS issued by CAA contained only generic aerodrome operating minima, and it was the obligations of operators to establish aerodrome operating minima for each aerodrome they intended to go to; those minima were subject to the approval of CAA. For example, EVA airways included the company established aerodrome operating minima in their flight operations supplementary manual (FOSM) and was approved by CAA.

With regard to "Aerodrome operating minima (AOM)", the 4.2.8 in the Annex 6 stated that *"The State of the Operator shall require that the operator establish aerodrome operating minima for each aerodrome to be used in operations and shall approve the method of determination of such minima. Such minima shall not be lower than any that may be established for such aerodromes by the State in which the aerodrome is located, except when specifically approved by that State."* This Standard does not require the State in which the aerodrome is located to establish aerodrome operating minima.

In accordance with the aforementioned standard, CAA has prescribed in the article 28 of Aircraft Flight Operation Regulations that "*An operator shall establish aerodrome operating minima for each aerodrome to be used in operations. Such minima shall not be lower than any that may be established for such aerodromes by the State in which the aerodrome is located. If the aerodrome operating minima has not been established by the State in which the aerodrome is located, the operator shall establish such minima, which will be carried into effect after approval by CAA.*"

Operators shall implement the aforementioned regulation by adding required contents in company manuals such as Operations Specifications, FOM, route manual, and Jeppesen charts and AIP procedures. Operators shall also firmly order flight crew members to follow the AOM prescribed

by the CAA of our nation, by the local CAA in charge of the aerodrome and by those in aeronautical charts. Such minima shall be treated as the lowest standard for takeoff, approach and landing.

In our country, it is the responsibility of the Air Traffic Services division in CAA for issuing AIPs. As for Opspecs, FOMs, and route manuals, operators shall review and revise these manuals by following internal process, and summit such manuals to the Flight Standards Division in CAA for approval. Thereby operators shall conduct operations accordingly.

1.18.6 Approach and Landing Accident Reduction (ALAR) tool kit

The Flight Safety Foundation (FSF) Approach and Landing Accident Reduction (ALAR) toolkit is a collection of tools and awareness material designed to help reduce the frequency and severity of approach and landing accidents and incidents, including controlled flight into terrain (CFIT) accidents. The toolkit is the product of work which was carried out by the FSF international ALAR Task Force and published in 1998.

The ALAR Briefing Notes (BN) (Attachment 1-13) are a fundamental component of the Toolkit. The following Briefing Notes are particularly relevant to CFIT avoidance:

BN 1.1 Operating Philosophy

BN1.3 Golden Rules

BN 1.4 Standard Calls

BN 1.6 Approach Briefing

BN 2.2 Crew resource Management

BN 6.1 Be Prepared to Go Around

BN 7.2 Constant-angle Nonprecision Approach

1.18.7 Sequence of events

Time	Event	Source
1730	The visibility at RCQC is 2,400	METAR
1741:29	CM2：T/O briefing Sosan one tango	CVR
1741:32	CM2：taxi ck list completed	CVR

Time	Event	Source
1742	Kaohsiung GND informs GE222 that the visibility at RCQC is below the minimum.	CVR
1745:00	GE222 takeoff from Kaohsiung Airport	FDR/CVR
1745:05	CM1：gear up, yaw damper on, FDR shows on 2 sec. latter.	CVR/FDR
1745:50	Flap Up, Speed select: 151	CVR/FDR
1749:46~1904:26	CM1 had cough、ah and sneeze Intermittently	CVR
1750:51	GE222 arrived 7,000 feet	CVR/FDR
1751:37	CM2 listen ATIS(Kilo: 190/21G32,800)	CVR
1754:58	CM1 yawn	CVR
1801:00	ATIS(Lima)shows the VIS. is 800	CVR
1810:17	CM1：I am tired	CVR
1810:51~1845:00	Holding at RCQC VOR 201 13 nautical miles	CVR
1845:04	APP. Approve GE222 runway 20 VOR approach	CVR
1848:22	App. Vector GE222 Heading 020, descend & maintain 5,000 feet	CVR/FDR
1853:19	CM2: This is basic mode sir.(教官這是 Basic mode)	CVR
1855:10	APP. Vector GE222 left turn 230 descent and maintain 2,000 feet clear runway 20 VOR Approach	CVR/ATC
1857:25	GE222 down to 2,000 feet	FDR
1859:18	CM1consent to preset the next select alt. at 400	CVR

Time	Event	Source
1859:21	The select altitude shows 360	FDR
1900:23	CM2：風那麼大飛不進去	CVR
1901:01	CM2：VOR Star	CVR
1901:13	CM2 contact to TWR and continue approach	CVR/ATC
1902:30	GE222 start to descent，Course setting: 201	FDR
1902:57	CM2: passing 5 nautical miles, CM1: Flap 15	CVR
1903:08	Flap 15	FDR
1903:36	Brush setting: Fast	CVR
1903:38	TWR report wind information：250/19	CVR/ATC
1903:39	L/G DN	FDR
1903:51	CM1：Flap 30	CVR
1904:02	Flap 30	FDR
1904:07	CM1 問：290 風嗎? CM2 回答 250	CVR
1904:23	GE222 passing 1,000 feet	FDR
1905:09	GE222 passing 500 feet	CVR/FDR
19905:10	Select vertical speed shows: -600 fpm	
1905:12	CM1：alt star 300	CVR
1905:13	Select altitude shows: 280	FDR
1905:14	Select vertical speed shows: -300 fpm	
1905:25	CM1：噯 200,Select vertical speed shows: -400 fpm	CVR
1905:28	Select Alt. :160, RA: 350	FDR
1905:36	CM2：alt star Select vertical speed	CVR

Time	Event	Source
	shows: -700	
1905:38	CM2：我們要到 0.2 浬	CVR
1905:40	CM2：1.5, Select vertical speed shows: -500	CVR
1905:43~1906:13	Select vertical speed shows: -100	FDR
1905:44	Auto pilot disengage,　RA: 232	CVR/FDR
1905:45~1905:57	Bank to the left, max. 10°	FDR
1905:48	CM1：Keep 200(保持 200 啊) P Alt. : 208, RA:223	CVR
1905:56~57	PAlt:179~168, RA: 165~149	FDR
1905:58	CM1：Runway in sight?(看到跑道了嗎)P Alt. 179, RA: 140	CVR
1905:59	FDR shows Yaw damp off, ADU caution, P Alt. 192, RA: 146	FDR
1906:00~1906:09	Bank to the left, 10 to 20 back to 10	FDR
1906:05~06	PAlt:166~170, RA: 162~134	FDR
1906:06~9	Pitch change fm -1.6 to -9	FDR
1906:07	CM2：Runway not in sight(沒有),PAlt.: 161, RA: 143	CVR
1906:08	CM1：Runway not in sight (沒有) PAlt: 164, RA: 143	CVR
1906:09~10	PAlt:131~99, RA: 120~64	FDR
1906:10	CM2: No Sir(教官沒有)	CVR
1906:11	CM1 & CM2：go around,PAlt: 72, RA: 48	CVR
1906:13	Unident. Sound, Palt: 39, RA: 16	CVR
190615	Left Eng. NP, NL & NH drop	FDR

Time	Event	Source
1906:16	CM2：go around, Palt: 23, RA: 0	CVR
1906:17	TWR：Roger	CVR
1906:18	Unident.　sound	CVR/scene

IV. Appendices

Appendix 1-1 TNA BKK SIM training syllabus

TransAsia	ATR FLEET TRAINING PROGRAM	REV. 27 DATE 15 JAN 2009 PAGE 8-1-31

INITIAL TRAINING

FFS – 07

TAKE-OFF DATA

INIT SETTINGS

AIRCRAFT	FROM/TO	FLT NBR
ATR72-212A	RCYU/RCSS	010

CRZ FL	CRZ WIND	ALTN
FL 90		RCSS

ZFCG	ZFW	RAMP FUEL
	43,200	3,800

TOW	TOCG
47,000	27%

ATIS

RWY..... 03
WIND..... 030 / 5
VISI..... 10 KM
RVR.....
CEILING 8,000
TEMP..... 10
DEW POINT....
QNH 1013
QFE.....
RWY COND... DRY

NOTE:

INITIAL TRAINING

FFS – 07

Subject

1. Preliminary Cockpit Preparation
2. Start Up Engines(Abnormal conditions)
3. Takeoff (RCYU RWY 21)
4. Visual Traffic Patterns
5. Climb to 9000ft
6. Air Work (Steep Turn, Stall Recovery, Unusual Attitude Recovery, TCAS Exercise)
7. LOC App (G/S Out) RCSS RWY 10
8. Blue HYD Low Level
9. Reduced Flap Landing
10. Takeoff (RCSS RWY 10)
11. Engine Flame Out After V1
12. Contingency Procedure
13. Single Engine ILS App (RCSS RWY 10)
14. Single Engine Go-Around
15. Single Engine ILS App (RCSS RWY 10)
16. Single Engine Landing
17. Takeoff (RCSS RWY 10)
18. Engine Fire Before V1
19. Emergency Evacuation

Flight Plan

Engine start-up problems. Takeoff and climb to 9,000 ft. Air work under icing conditions. Hyd problem, no flap landing. Takeoff, engine flame out after V1, single-engine ILS approach, single-engine go-around, and single-engine landing. Takeoff, engine fire before V1, emergency evacuation.

Session Objectives

Satisfactory Performance Comply with ATR Pilot Practical Test Standard

Reference

FCOM part 2 – Normal & Emergency Procedures
Normal & Emergency Checklist

復興航空 TransAsia Airways

ATR72 INITIAL/TRANSITION TRAINING

SIMULATOR TRAINING

Trainee Name :	Trainee License No:	Trainee Position: ☐Captain ☐F/O		
Trainee Employee ID	Crew Member:	SESSION FFS – 07	Simulator Hours	
Instructor Name :	Instructor License No:		PF :	PM :
Instructor Employee ID	Instructor Position: ☐ Check Airman ☐ Instructor		Seat	Seat
Date: Y M D			Total PF Hours :	Total PM Hours :

S: Satisfactory **U:** Un-satisfactory **N:** Not applicable

No	ITEMS		S	U	N
1	**PRELIMINARY COCKPIT PREPARATION**				
2	**ABNORMAL ENG START**				
3	**TAKEOFF (RCYU RWY 21)**				
4	**VISUAL TRAFFIC PATTERNS**				
5	**CLIMB**	9,000 ft			
6	**AIR WORK: STEEP TURN STALL RECOVERY (*) UNUSUAL ATTITUDE RECOVERY TCAS/EGPWS**	Icing conditions			
7	**LOC APP (G/S OUT) RCSS RWY 10**	VIS 5,000 M, Ceiling 1,500 ft, Wind 080/10			
8	**BLUE HYD LOW LEVEL**	Abnormal			
9	**REDUCED FLAP LANDING (ICING / NORMAL, *)**				
10	**TAKEOFF (RCSS RWY 10)**	Normal condition			
11	**ENGINE FIRE AFTER V1**	Emergency			
12	**CONTINGENCY PROCEDURE**				
13	**SINGLE ENGINE ILS APP (RCSS RWY 10)**	ILS minimum			
14	**SINGLE ENGINE GO-AROUND**				
15	**SINGLE ENGINE ILS APP (RCSS RWY 10)**	Raw data			
16	**SINGLE ENGINE LANDING**				
17	**TAKEOFF (RCSS RWY 10)**	Wind 100/10			
18	**ENGINE FIRE BEFORE V1**	Inextinguishable			
19	**EMERGENCY EVACUATION**				

***: IP discretion**

RECOMMENDATION AND ACTION			
P: Proficient	**G**: General	**A**: Acceptable	
SUBJECT	**P**	**G**	**A**
System Knowledge			
Flying Accuracy			
Use Of AFCS			
Flight Planning			
IFR Procedures			
Crew Coordination			
General Performance			
Decision Making			
Briefing			
CRM			

COMMENT:

IP Signature	License No.	Trainee Signature

INITIAL TRAINING

EVALUATION

TAKE-OFF DATA

INIT SETTINGS

AIRCRAFT	FROM/TO	FLT NBR
ATR72-212A	RCYU/RCSS	010

CRZ FL	CRZ WIND	ALTN
FL 90		RCSS

ZFCG	ZFW	RAMP FUEL
	41,200	3,800

TOW	TOCG
45,000	27%

ATIS

RWY..... 03
WIND..... 030 / 5
VISI..... 10 KM
RVR.....
CEILING 8,000
TEMP..... 10
DEW POINT....
QNH 1013
QFE.....
RWY COND... DRY

NOTE:

EVALUATION

Subject

1. Preliminary Cockpit Preparation
2. Start Up Engines (Abnormal conditions)
3. Takeoff (RCYU RWY 03)
4. Visual Traffic Pattern, touch and go
5. Climb
6. Air Work (Steep Turn, Stall Recovery, Unusual Attitude Recovery)
7. Blue HYD Low Level
8. LOC App (G/S Out) RCSS RWY 10
9. Reduced Flap Landing
10. Takeoff (RCSS RWY 10)
11. Engine Flame Out After V1
12. Contingency Procedure
13. Single Engine ILS App (RCSS RWY 10)
14. Single Engine Go-Around
15. Single Engine ILS App (RCSS RWY 10)
16. Single Engine Landing
17. Takeoff (RCSS RWY 10)
18. Engine Fire Before V1
19. Emergency Evacuation
20. (For CAPT only) 3 Traffic Patterns on CM2

Flight Plan

Engine start-up problems. Takeoff traffic patterns, then follow SID and climb to 9,000 ft. Air work under icing conditions (steep turns, approach to stall and recovery). HYD problem, no flap landing. Takeoff, engine flame out after V1, single-engine ILS approach, single-engine go-around, and single-engine landing. Takeoff, engine fire before V1, emergency evacuation.

Session Objectives

Satisfactory Performance Comply with ATR Pilot Practical Test Standard

Reference

FCOM part 2 – Normal & Emergency Procedures
Normal & Emergency Checklist

復興航空 TransAsia Airways

ATR72 INITIAL/TRANSITION TRAINING

SIMULATOR CHECK

Examinee Name :	Examinee License No:	Examinee Position: ☐Captain ☐F/O		
Examinee Employee ID	Crew Member:	SESSION CHECK	Simulator Hours	
Examiner Name :	Examiner License No:		PF :	PM :
Examiner Employee ID	Examiner Position: ☐ Check Airman ☐ Instructor		Seat	Seat
Date: Y M D			Total PF Hours :	Total PM Hours :

S: Satisfactory **U:** Un-satisfactory **N:** Not applicable

No	ITEMS		S	U	N
1	**PRELIMINARY COCKPIT PREPARATION**				
2	**ABNORMAL ENG START**				
3	**TAKEOFF (RCYU RWY 03)**				
4	**CLIMB**	Follow SID			
5	**AIR WORK: STEEP TURN TCAS STALL RECOVERY (*) EGPWS UNUSUAL ATTITUDE RECOVERY**	Icing conditions			
6	**BLUE HYD LOW LEVEL**	Abnormal			
7	**LOC APP (G/S OUT) RCSS RWY 10**	VIS 5,000 M, Ceiling 1,500 ft, Wind 110/10			
8	**REDUCED FLAP LANDING**	Wind 170/10			
9	**TAKEOFF (RCSS RWY 10)**				
10	**ENGINE FIRE AFTER V1**	Emergency			
11	**CONTINGENCY PROCEDURE**				
12	**SINGLE ENGINE ILS APP (RCSS RWY 10)**	ILS minimum			
13	**SINGLE ENGINE GO-AROUND**				
14	**SINGLE ENGINE ILS APP (RCSS RWY 10)**	Raw data			
15	**SINGLE ENGINE LANDING**				
16	**TAKEOFF (RCSS RWY 10)**	Wind 100/10			
17	**ENGINE FIRE BEFORE V1**	Inextinguishable			
18	**EMERGENCY EVACUATION**				
19	**3 TRAFFIC PATTERNS ON CM2** (Including T/O S/E, ILS APP, Full Stop) (CAPT only)				

*: IP discretion

RECOMMENDATION AND ACTION			
P: Proficient	**G**: General	**A**: Acceptable	
SUBJECT	**P**	**G**	**A**
System Knowledge			
Flying Accuracy			
Use Of AFCS			
Flight Planning			
IFR Procedures			
Crew Coordination			
General Performance			
Decision Making			
Briefing			
CRM			

COMMENT:

Check Result: ☐**Pass** ☐**Fail** ☐**Need 1 more session then check**

CP Signature	License No.	Examinee Signature

2014 2nd RECURRENT TRAINING

WEATHER

RCSS RWY 10, 110/10, VIS 5000M, 10/6, 1013

INIT PAGE

FLT NBR: 239

FORM	TO	ALTN
RCSS	RCBS	RCSS
CO RTE		ALTN /CO RTE
CRZ FL		CRZ TEMP
FL 100		
TRIP WIND		TRIP WIND
HD -15		175 Nm

INIT NEXT PAGE

ZFW：41200 LB　　ZFWCG：28.9%

FOB：3800 LB　　GW：

NOTES

RWY COND:DRY　　FPLN:MU2Q,W6

AIR COND:ON

ANTI ICE OFF:LEVEL 1

PERF PAGE RCSS RWY 10	**PERF PAGE**
V1:	V1:
VR:	VR:
V2:	V2:

TIME	EVENTS	AP	FD
	INIT GATE		
	1. TRANSIT COCKPIT PREPARATION		
	2. ENGINE START		
	3. RCSS RWY T/O	V	V
	4. GNSS PRACTICE		
	5. ACW TOTAL LOSS		
	6. UNUSUAL ATTITUDE RECOVERY		
	7. RCBS RWY 24	V	V
	INIT HOLDING POINT-RCBS RWY 06		
	8. RCBS RWY 06 T/O	V	V
	9. BOTH ENG FLAME OUT (ENROUTE)	V	V
	10. ILS RWY 06 APPR	V	V
	11. RCBS T/O ENG FLAME OUT(AFTER V1)	V	V
	INIT TAKE OFF-BCBS RWY 06		
	12. S/E GO AROUND(REJECTED L/D)(MANUAL FLIGHT)(CAT I, NIGHT, SHRA+, CROSS WIND, WIND SHEAR)		
	13. S/E L/D(RAW DATA)(MANUAL FLIGHT)(CAT I)		V
	14. REJECTED T/O(ON GROUND ENG FIRE)		
	15. EMER EVACU		
	16. TRAFFIC PATTERN(RCBS) (MANUAL FL)(TAIL WIND15 KTS) (CORSSWIND CAPT 35KTS, F/O 15KTS)		

復興航空 TransAsia Airways

ATR FLEET PROFICIENCY TRAINING YEAR 2014 (2ND)

Trainee:	Crew Member:	Day Month Year 2014
☐ IP/CP ☐ CAPT ☐ F/O	**SIMULATOR TIME** PF: PM:	**Instructor :**

LOFT: RCSS→RCBS	LOCAL:RCBS

5: Proficient **4**: Satisfactory **3**: Acceptable **2**: Improvement required **1**: Unsatisfactory

NO	ITEM	5	4	3	2	1
1	COCKPIT PREPARATION					
2	ABNORMAL ENG START (*)					
3	RCSS TAKEOFF, (RWY 10) / SID TO RCBS					
4	TCAS / EGPWS EXERCISE (*)					
5	STEEP TURN(ICING CONDITION)					
6	STALL RECOVERY (*)(ICING CONDITION)					
7	UNUSUAL ATTITUDE RECOVERY					
8	ACW TOTAL LOSS					
9	RCBS LDA R/W 24 APP L/D(Below 3000' CREW INCAP)					
10	RCBS T/O Both ENG FLAME OUT (RCBS L/D) (6,000 feet)					
11	RCBS T/O ENG FLAME OUT AT T/O (ILS R/W 06 APP)					
12	S/E GO AROUND (REJECTED LANDING) (Manual Flight) (CAT I,NIGHT,SHRA+,CROSS WIND,WIND SHEAR)(*)					
13	S/E L/D (RAW DATA)(Manual Flight)(CAT I)					
14	REJECTED T/O(ON GROUND ENG FIRE)					
15	EMER EVACU					
16	TRAFFIC PATTERN (RCBS) (MANUAL FLT) (TAIL WIND 15KTS) (CROSSWIND CAPT 35KTS, F/O 15KTS)					

1. (*) IP discretion
2. Syllabus sequence at IP discretion.
3. If the grade will be marked on "2" or "1", please add comment as clear as possible on the back for additional training reference.

RECOMMENDATION AND ACTION					
5: Proficient **4**: Satisfactory **3**: Acceptable **2**: Improvement required **1**: Unsatisfactory					
ITEM	**5**	**4**	**3**	**2**	**1**
1. SYSTEM KNOWLEDGE					
2. FLYING ACCURACY					
3. FLIGHT PLANNING					
4. IFR PROCEDURE					
5. SITUATION AWARENESS					
6. SITUATION HANDLING					
7. DECISION MAKING					
8. BRIEFFING					
9. CRM					
Result of Training: ☐Satisfactory ☐Unsatisfactory					
IP Signature **License No**			**Trainee Signature**		

Appendix 1-2 Observations of TNA simulator training sessions

Observations (Attachment 1-5 TNA simulator training observations)**:**

1. 19 subjects and 5 maneuvers (steep turn, stall recovery, unusual attitude recovery, TCAS, EGPWS) were carried out in 2 hours.
2. Traffic pattern altitude was 1,200 feet.
3. Non precision approach was conducted by step-down.
4. Unusual attitude of pitch high with bank was told to recover by leveling wing first then lowering the nose. The trainee did not challenge the instructor for not in compliance of TNA Flight Crew Training Manual.
5. DH was set on Electronic Attitude Director Indicator (EADI) for non precision approach.
6. Both pilots operated AFCS control panel with AP engaged.
7. ON GROUND ENG FIRE followed by ON GROUND EMER EVACUATION, evacuation was executed immediately after second bottle was discharged without checking whether the fire extinguished.
8. One pilot failed by one dot high on 1000 feet but the other passed with 4 white PAPI on short final and landed long.
9. TO/MCT was not selected on PWR MGT panel in EGPWS maneuver.
10. CL was not set OVRD position in TCAS escape maneuvers.
11. The following discrepancies were not corrected by the instructors.
    - ✓ 4 white PAPI was displayed on short final, PM did not make callout and PF was not instructed to correct it.
    - ✓ PM did not make callout for speed low or high on short final. PF was not instructed to correct it.
    - ✓ None of the pilots made “Approaching minimum” standard callouts during non precision approach.
    - ✓ None of the pilots made “OM/FAF” standard callouts during approach.
    - ✓ “Minimum” standard callouts were not made.

- ✓ PM “FLAPS ZERO” and PF “CHECKED” standard callouts were missing during some flaps operation.
- ✓ PM “GEAR UP SET” and PF “CHECKED” standard callouts were missing during some landing gear operation.
- ✓ “Level two on” standard callouts in icing condition were not made.
- ✓ Start timing on start push button depressed during engine start.
- ✓ CM 1 “STARTER ON” CM 2 “STARTER LGHT OFF” CM 1 “CHECKED” standard callouts were missing during engine start.
- ✓ CM 1 “TIMING” and “NOTCH” standard callouts were missing during take-off .
- ✓ Missing some AFCS mode selection standard callout s.
- ✓ Missing ADU annunciation standard callouts .
- ✓ ACW TOTAL LOSS abnormal checklist was partially read.
- ✓ After Take Off checklist did not execute.
- ✓ The slip indicator was not centered during single engine operation.
- ✓ The aircraft was descending during single engine go around without PM callout.
- ✓ LOC/GS deviation standard callout was not made.
- ✓ Stabilized approach criteria were not met during raw data ILS approach.
- ✓ LO BANK was selected in whole simulator session.
- ✓ NDB identification was not made by pilots.

Appendix 1-3 Observations of TNA line operations

Observations (Attachment 1-6 History of TNA line observation flights):

The observation flights were conducted on ATR 72-212A aircraft type, mainly on 500, a few of the flights on 600.

1. Performed the normal checklists by memory, especially after takeoff and after landing one.
2. Not referring to abnormal checklists while encountering abnormal conditions such as, starter fault, bleed air fault and ice detection fault.
3. During system preparation, clocks were not correctly set, some crew dismissed that procedure.
4. During start engine phase, “FUEL FLOW RISING”, “ITT RISING”, “OIL PRESSURE RISING” call outs were supposed to be responded “CHECK” by CM1 respectively, certain flight crew did not correctly respond. “45% NH”, “STARTER LIGHT OFF”, “ITT DROP AND STABLE, NORMAL START” call outs were properly performed by CM2.
5. During before takeoff phase, “LIGHT ON” was supposed to be performed by checking spoiler light panel after the pilot in charge of checking “SPOILER UP”. It seems this procedure was a purely call out than an actual checking the associated lights.
6. Take off TORQUE was not computed.
7. During climb phase, “GEAR UP SET” was not announced by PM; “SET SPEED TO WHITE BUG” were not called out by PF after the “ACCELERATION ALTITUDE” call by PM. Either “TEN MILES” or “ONE ZERO THOUSAND FEET” call outs were missing in certain flights.
8. Some crews were not following the climb speed specified in the SOP.
9. No call outs were made for IAS, V/S and HDG change and adjustment during AFCAS operation
10. During briefing, certain flight crew did not cross check the FMC or the approach course setting against the aeronautical charts.
11. During approach phase, “OM/FAF/FAP, ALTITUDE _____ FEET”, “CHECKED ____ FEET” call were not performed in certain flights, reported airport in sight way before 30NM to get a visual approach from ATC, and apply basic mode for no proper cause. Flied too low on

some flight, causing PAPI four red indication, yet no challenge and response call from PF and PM.

12. During landing rollout phase, “LOW PITCH LIGHTS ON” call out was missing on certain flights.
13. During after landing phase, certain flight crew performed the after landing checklist by memory, with holding the paper one at hand.
14. Flight crew did not announce the navigation radios in used or were identified before approach, and cross check chart plate number and correct date with each other.
15. Approach speed was too fast (+20kts). PM did not make call out.

Appendix 1-4 RCQC VOR RWY20 Flight Inspection

儀航程序飛航測試報告表
FLIGHT INSPECTION REPORT-INSTRUMENT PROCEDURE

程序名稱	狀態	地點	跑道	使用設備
[馬公] -- [進場]--[VOR RWY20]	修改	馬公	20	[馬公]--[VOR]--[馬公MKG]
[馬公] -- [離場]--[TOROX ONE DEP(TR1)]	複查	馬公	20	[馬公]--[TOW]--[馬公MAGONG]
[馬公] -- [進場]--[NDB RWY20]	複查	馬公	20	[馬公]--[HOM]--[馬公BM]
[馬公] -- [離場]--[SWORD ONE DEP(SW1)]	複查	馬公	20	[馬公]--[DME]--[馬公MKG VOR]

日期 Date	2013/7/23

測試項目	滿意	不滿意	原因
[INR]--[下降梯度]	ˇ		
[INR]--[飛航操作及信號攔截]	ˇ		
[INR]--[地障辨認]	ˇ		
[INR]--[無線電通信]	ˇ		
[INR]--[航點及待命]	ˇ		
[INR]--[駕駛操作及人因考量]	ˇ		
[INR]--[最後進場航道與跑道之對正]	ˇ		
[INR]--[繞場]	ˇ		
[INR]--[其他]	ˇ		
[MII]--[爬昇梯度]	ˇ		
[MII]--[飛航操作及信號攔截]	ˇ		
[MII]--[地障辨認]	ˇ		
[MII]--[無線電通信]	ˇ		
[MII]--[航點及待命]	ˇ		
[MII]--[駕駛操作及人因考量]	ˇ		
[MII]--[其他]	ˇ		
[OUR]--[爬昇梯度]	ˇ		
[OUR]--[地障辨認]	ˇ		
[OUR]--[飛航操作及信號攔截]	ˇ		
[OUR]--[無線電通信]	ˇ		
[OUR]--[航點及待命]	ˇ		
[OUR]--[駕駛操作及人因考量]	ˇ		
[OUR]--[其他]	ˇ		

備考 Remarks：	依航管組申請執行 馬公機場VOR RWY20進場程序修訂及TR1、SW1離場、NDB RWY20進場程序複查查核作業 經測試，所設計之儀航程序符合飛航所需，航路上各助導航裝備工作正常 測試程序圖及軌跡紀錄如附件。

設施使用類別 Facility Classification	
ˇ	無限制用(Unrestricted)
	限制使用(Restricted)
	不能使用(Unusable)
測試人員 [redacted]	

附件
測試程序圖及軌跡紀錄

☐新訂
☑修訂
☑複查

馬公機場儀航程序飛測草案

102.07.

1. 1330L馬公機場起飛，TR1 離場，爬高保持 5000 加入W6。
2. 自 SEGMA實施VOR RWY20 進場，LOW-APCH。
3. LOW-APCH之後實施TR1 離場，爬高保持 5,000 至COSTA，實施NDB RWY20 進場，LOW-APCH。
4. LOW-APCH之後實施SW1 離場，爬高保持FL130 加入A1，返回松山機場落地。

飛測重點：

- 劃底線者為施測項目 ，如非必要請勿中斷。

馬公機場
MAGONG AD

RCQC
VOR RWY20

KAOHSIUNG APP	MAGONG TWR	GROUND	ATIS
128.1 234.8	118.3 236.6	121.9	127.05

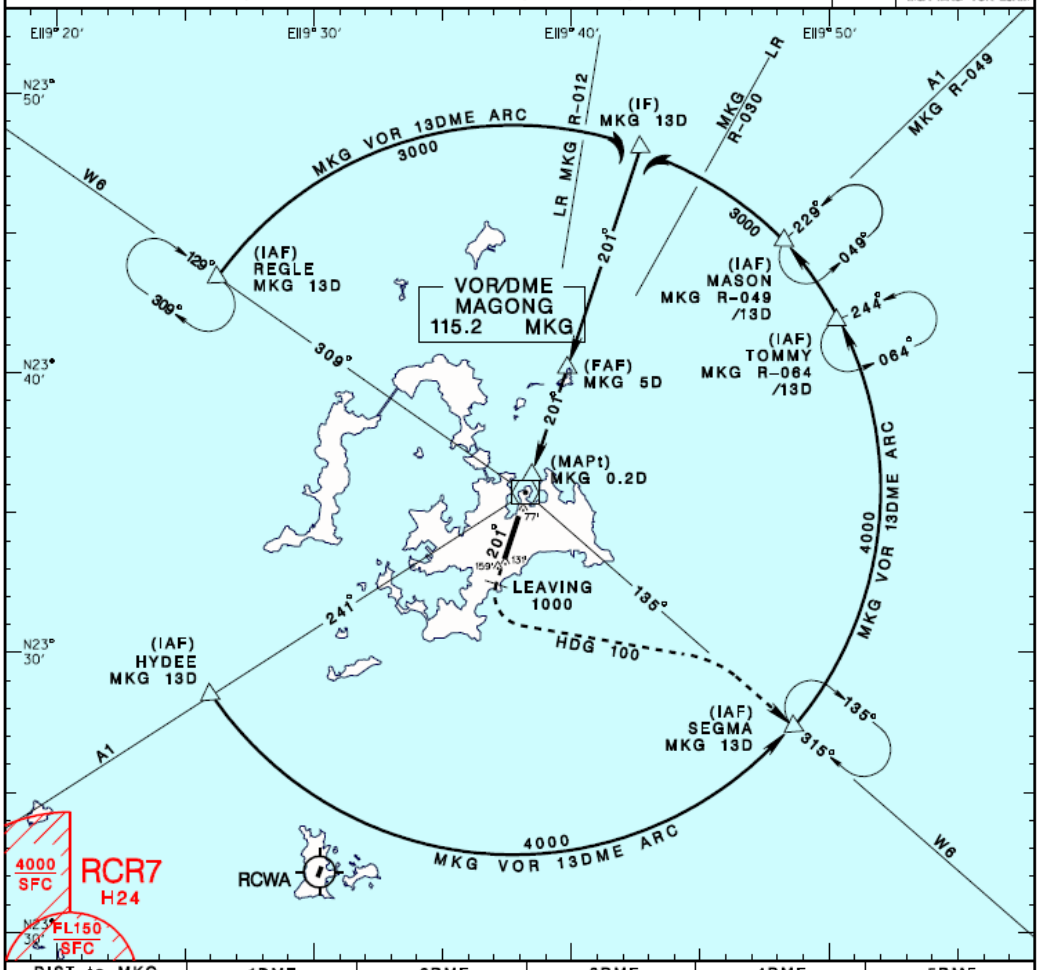
Apt Elev: 103' Rwy20 THR Elev: 46' Trans Level: FL130 Trans Alt: 11,000'

BEARINGS ARE MAGNETIC; DISTANCES ARE NAUTICAL MILES; ELEVATIONS, HEIGHTS IN FEET

VAR 3°W

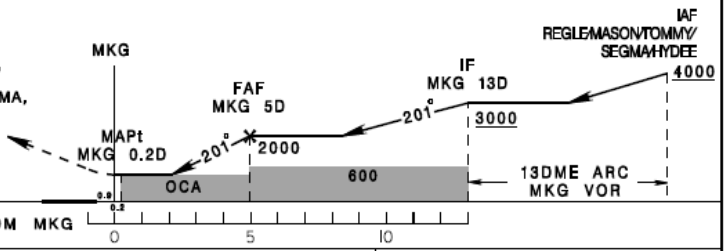
2000'

MSA MKG VOR 25NM



DIST to MKG	1DME	2DME	3DME	4DME	5DME
ADVISORY ALT	700	1010	1330	1650	1970

MISSED APCH:
CLIMB ON MKG R-201 TO 1000,
THEN TURN LEFT HDG 100
TO TRACK MKG R-135 TO SEGMA,
MAINTAIN 3000 AND HOLD.



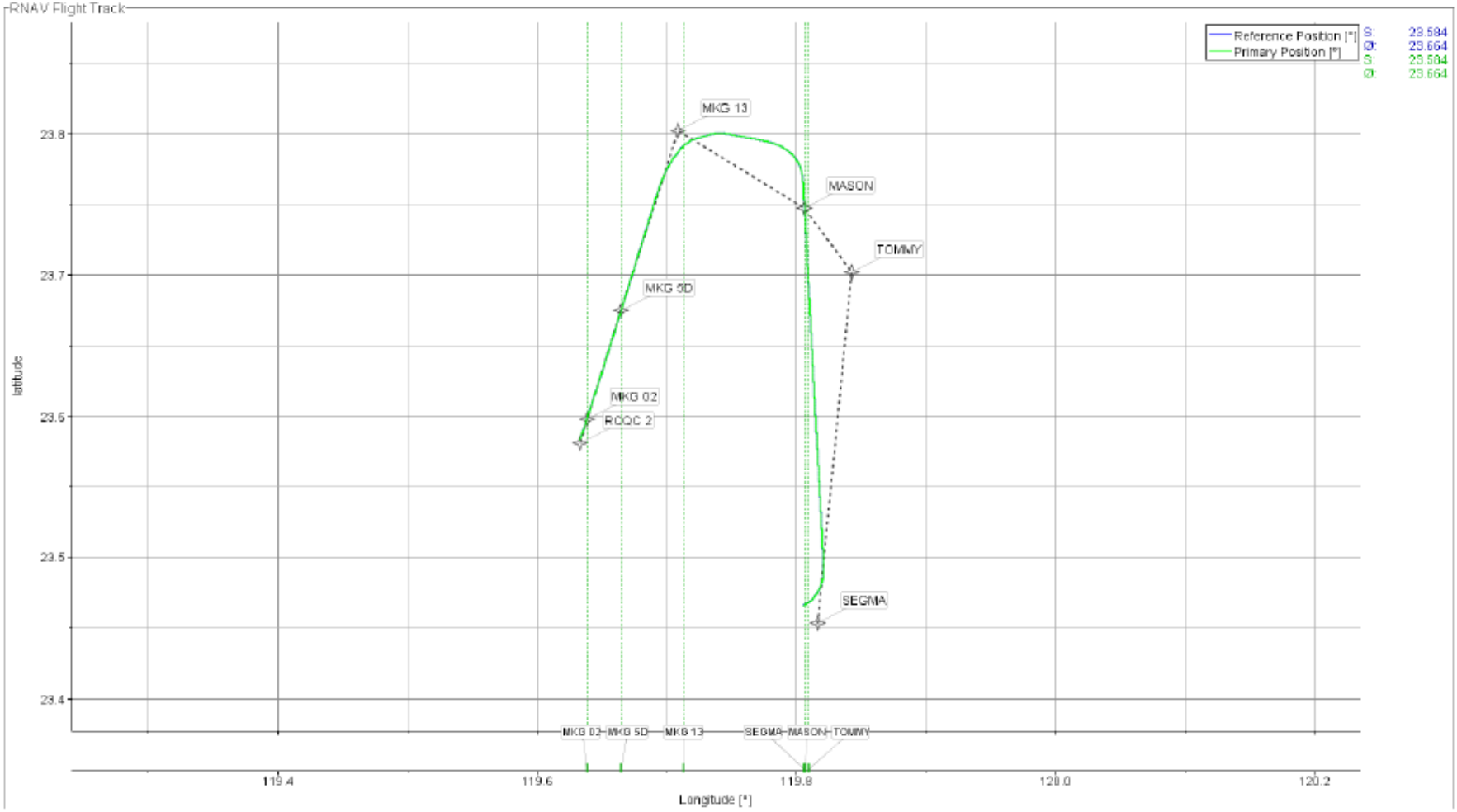
MINIMA (OCA IN FT, VIS IN M, OCH IN FT)				
CATEGORY	A	B	C	D
STRAIGHT IN	330/1600 284	330/1600 284	330/1600 284	330/1600 284
CIRCLING	620/1900 517	620/2800 517	710/3700 607	800/4600 697

1. CIVIL AIRCRAFT USE EAST TRAFFIC PATTERN.
2. DUE TO PROXIMITY OF RCR7, ARR TFC FROM SW(A1) SHALL CROSS HYDEE AT OR ABOVE FL160, PROCEED TO MKG THEN SEGMA FOR APCH, UNLESS OTHERWISE CLEARED BY ATC.
3. PRIOR COORDINATION WITH CAF SHALL BE DONE BY ATC WHEN ISSUING CLEARANCE PENETRATING RCR7 AIRSPACE.
4. CAUTION CLOSE-IN OBSTACLES (TREES, POLES & WATER TOWER): 159FT MSL, 794m & 131FT MSL, 292m SOUTH OF THR02; 77FT MSL, 436m NORTH OF THR20.

* DME REQUIRED

REV: MINIMA; FINAL COURSE

RNAV AC B-00101; Company TWCAA; Operator Cheryl; Regulations ICAO; Schedule Periodic
7 Wpts: SEGMA TOMMY MASON MKG 13 MKG 5D MKG 02 RCQC 2
2013-07-23 06:57:33 #9; Inspection_2013-07-23_RNAV Check; ONLINE



Civil Aeronautics Administration
交通部民用航空局
Ministry of Transportation and Communications

VOR Result Page, Radial, Periodic Inspection MKG, Magong

VOR: MKG;RNAV-Procedure, RCQC RWY 20 IAP VOR RWY20 [SEGMA,TOMMY,MASON,MKG 13,MKG 5D,MKG 02,RCQC 2]Operator: Cheryl;Company: TWCAA;
Regulations: ICAO; Date: 2013-07-23 Start: 06:57:33, Stop: 07:09:06; Software: AD-AFIS-280 V5.17.0
Inspection: Inspection_2013-07-23_RNAV Check

TX 1 Run #9.RX1						
Run	Item	Unit	Value	Diff	Start	Stop
Current	Ref. Altitude	[ft]	n.a.	n.a.	5410	360
	Ref. Distance	[NM]	n.a.	n.a.	12.07	-0.68
	Bearing Error	[°]	0.48	n.a.	n.a.	n.a.
	ProcedureNotes	Inconsistent Facility Data.				
Run 8 RX 1	Ref. Altitude	[ft]	n.a.	n.a.	164	5399
	Ref. Distance	[NM]	n.a.	n.a.	1.39	-11.63
	Bearing Error	[°]	0.39	0.09	n.a.	n.a.
	ProcedureNotes					

TX 2						
Run	Item	Unit	Value	Diff	Start	Stop
Current	Ref. Altitude	[ft]	n.a.	n.a.		
	Ref. Distance	[NM]	n.a.	n.a.		
	Bearing Error	[°]		n.a.	n.a.	n.a.
	ProcedureNotes					

		TX 1			TX 2		
Item	Unit	Value	Distance of occurrence [NM]	Ref. Altitude of occurrence [ft]	Value	Distance of occurrence [NM]	Ref. Altitude of occurrence [ft]
Bends (Max)	[°]	-0.44	12.1	3200			
Roughness (Max)	[°]	-0.42	11.3	4320			
Signal Level (Min)	[dBW/m²]	-85.1	-13.2	3210			
Modulation Depth 30 Hz AM	[%]	31.0	-	-		-	-
Modulation Depth 9960 Hz AM	[%]	31.1	-	-		-	-
Deviation Ratio 30 Hz FM		16.4	-	-		-	-

Identification	PASS	✓	FAIL	
Collocation	PASS	✓	FAIL	

Result Notes

DVOR TX1 RWY#20 Low Approach測試，系統信號符合要求容差要求。

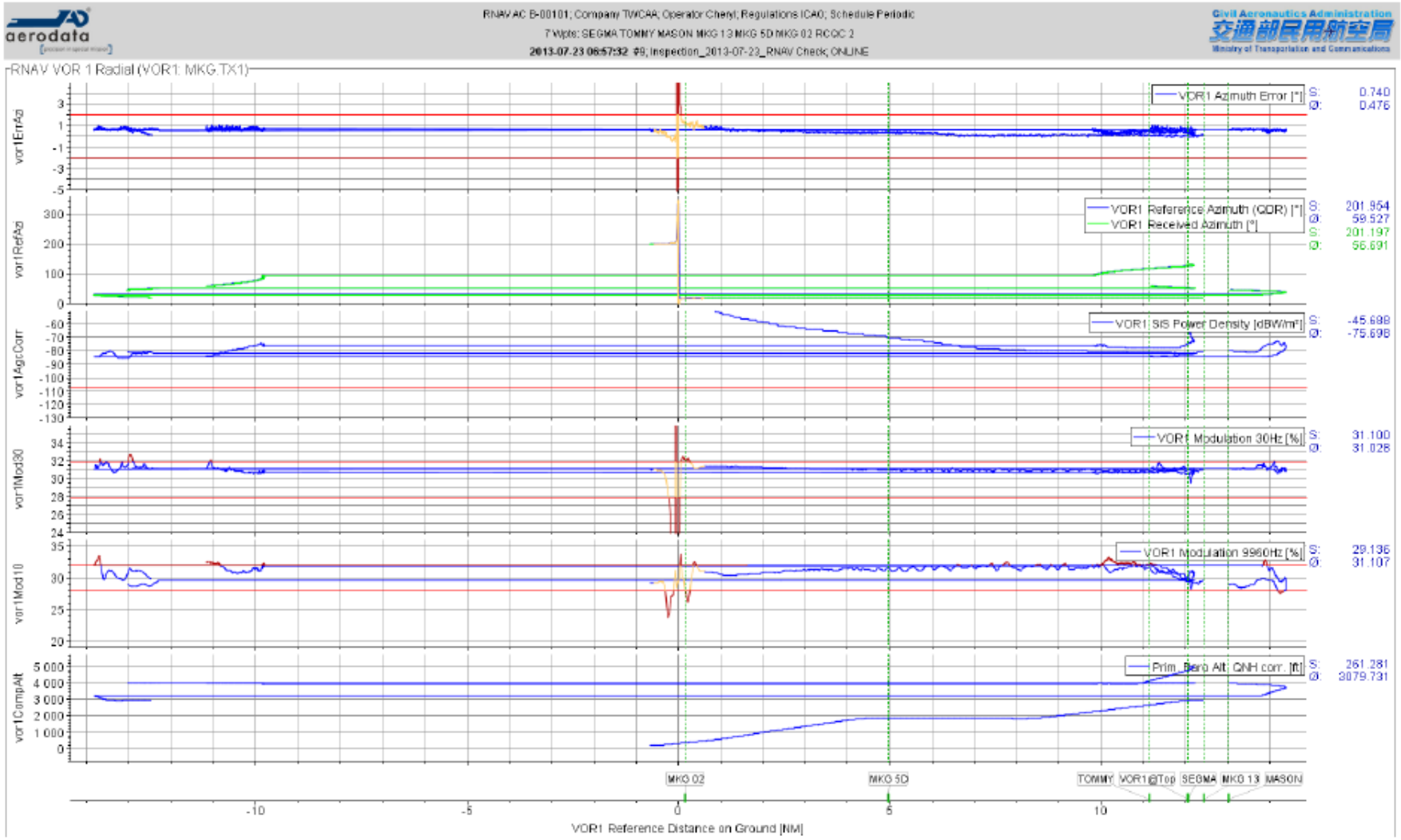
2013-07-23 07:09:10
Date

[redacted]
Signature

VOR Result Page, Radial, Periodic Inspection

VOR: MKG;RNAV-Procedure, RCQC RWY 20 IAP VOR RWY20 [SEGMA,TOMMY,MASON,MKG 13,MKG 5D,MKG 02,RCQC 2]Operator: Cheryl;Company: TWCAA;
Regulations: ICAO; Date: 2013-07-23 Start: 06:57:33, Stop: 07:09:06; Software: AD-AFIS-280 V5.17.0
Inspection: Inspection_2013-07-23_RNAV Check

Radial	TX 1				TX 2			
Sector [NM]	Alignment Error Average [°]	Bends Max. [°]	Roughness (Max) [°]	Signal Level Min. [dBW/m²]	Alignment Error Average [°]	Bends Max. [°]	Roughness (Max) [°]	Signal Level Min. [dBW/m²]
-5 - 0	0.57	-0.48	0.20	-45.7				
0 - 5	0.50	0.31	-0.18	-70.0				
5 - 10	0.18	0.20	-0.16	-80.2				
10 - 15	0.11	-0.08	0.15	-81.5				
15 - 20								
20 - 25								
25 - 30								
30 - 35								
35 - 40								
40 - 45								
45 - 50								
50 - 55								
55 - 60								
60 - 65								
65 - 70								
70 - 75								
75 - 80								
80 - 85								
85 - 90								
90 - 95								
95 - 100								
100 - 105								
105 - 110								
110 - 115								
115 - 120								
120 - 125								


RNAV AC B-00101; Company TWCAA; Operator Cheryl; Regulations ICAO; Schedule Periodic
7 Wpts: SEGMA TOMMY MASON MKG 13 MKG 5D MKG 02 RCQC 2
2013-07-23 06:57:32 #9; Inspection_2013-07-23_RNAV Check; ONLINE
RNAV VOR 1 Radial (VOR1: MKG.TX1)
VOR1 Azimuth Error [°]
S: 0.740
Ø: 0.476
VOR1 Reference Azimuth (CDR) [°]
VOR1 Received Azimuth [°]
S: 201.954
Ø: 59.527
S: 201.197
Ø: 56.691
VOR1 SIS Power Density [dBW/m²]
S: -45.698
Ø: -75.698
VOR1 Modulation 30Hz [%]
S: 31.100
Ø: 31.028
VOR1 Modulation 9960Hz [%]
S: 29.136
Ø: 31.107
Prim. Baro Alt. QNH corr. [ft]
S: 261.281
Ø: 3079.731
vor1ErrAz
vor1RefAz
vor1AgcCorr
vor1Mod30
vor1Mod10
vor1CompAlt
MKG 02
MKG 5D
TOMMY
VOR1@Top
SEGMA
MKG 13
MASON
VOR1 Reference Distance on Ground [NM]

Appendix 1-5 RCQC VOR RWY20 Special Flight Inspection

依據飛安會要求，依飛航指南馬公機場 VOR RWY 20 儀航程序，執行馬公機場 20 跑道端特高頻多向導航台(DVOR)之進場測試，測試程序說明如下：

第一次測試：使用後艙飛測系統(FIS)，依據 VOR 進場程序設定之航道為訊號源(NAV SOURCE)，以 R-021 幅向，3,000 呎高度，距離 VOR 導航台 10 海浬處執行進場測試，並以 330 呎高度通過 VOR 導航台。

第二次測試：使用後艙飛測系統(FIS)，依據 VOR 進場程序設定之航道為訊號源(NAV SOURCE)，以 R-021 幅向，3,000 呎高度，距離 VOR 導航台 10 海浬處執行進場測試，並以 200 呎高度通過 VOR 導航台。

第三次測試：依頒布之 VOR 進場程序以 MKG VOR 為訊號源，由 R-021 幅向，3,000 呎高度進場，距離 VOR 導航台 10 海浬處執行進場測試，並降落於馬公機場。

依飛安會需求，各次測試結果表列說明如下：

測試項目	第一次測試	第二次測試	第三次測試
CDI 於多少距離開始移動？	1.5 海浬	1.4 海浬	0.1 海浬
CDI 於多少距離偏離多少個 Dot？	最大約 2.0 Dot (於 0.2 海浬處)	最大約 1.90 Dot (於 0.2 海浬處)	最大約 2.0 Dot (於 0.1 海浬處)
VOR 之方位指針在多少距離開始移動？	0.5 海浬	0.4 海浬	0.1 海浬

1

Appendix 1-6 CAA Meeting Notices

抄件

裝

訂

線

交通部民用航空局　開會通知單

郵遞區號：
地　　址：
受文者：

發文日期：
發文字號：系統字
速別：普通件
密等及解密條件或保密期限：普通
附件：

開會事由：本區「儀航程序轉換至國際民航組織 PANS-OPS 規範」說明會

開會時間：中華民國 98 年 11 月 12 日(星期四)上午 9 時 00 分

開會地點：本局國際會議室

主持人：[redacted]

聯絡人及電話：[redacted]

出席者：國籍航空公司、外籍航空公司、國防部空軍司令部、國防部海軍司令部、國防部陸軍司令部、內政部空中勤務總隊、飛航服務總臺、本局飛航標準組、航站管理小組、飛航管制組

列席者：

副本：

備註：

一、各單位請至少派 2 員出席。

二、本局「儀航程序轉換至國際民航組織 PANS-OPS 規範」案由美商 The Washington Consulting Group, Inc.(WCG)團隊承辦，已完成桃園、高雄、松山、豐年等 4 個機場之儀航程序轉換及相關技術轉移，本會議將報告下列事項：
(一)本計畫期程及工作內容說明。
(二)轉換作業所發現之重要差異。
(三)儀航程序增修訂之建議。
(四)助航設施配置之改善建議。
(五)其他發現之問題，或預估可能發生之問題，及建議處理方式。

三、出示本開會通知單可於會議當日在臺北國際航空站停車場免費停車 1 次。

第1頁　共2頁

抄件

交通部民用航空局　開會通知單

郵遞區號：
地　　址：
受文者：

發文日期：
發文字號：系統字
速別：普通件
密等及解密條件或保密期限：普通
附件：

開會事由：本區「儀航程序轉換至國際民航組織 PANS-OPS 規範」案期末報告

開會時間：中華民國 98 年 11 月 12 日(星期四)下午 2 時 00 分

開會地點：本局 308 會議室

主持人：[redacted]

聯絡人及電話：[redacted]

出席者：飛航服務總臺、本局飛航標準組、航站管理小組、飛航管制組

列席者：

副本：

備註：響應環保，參加人員請自備環保杯。

局戳

抄件

交通部民用航空局　開會通知單

郵遞區號：
地　　址：
受文者：

發文日期：中華民國 99 年 1 月 18 日
發文字號：系統字第 0990002136 號
速別：普通件
密等及解密條件或保密期限：普通
附件：如文（990114 儀航程序轉換至 PANS-OPS 差異研討.doc）

開會事由：儀航程序轉換至 PANS-OPS 差異研討

開會時間：中華民國 99 年 1 月 25 日(星期一)下午 2 時 00 分

開會地點：本局 305 會議室

主持人：[redacted]

聯絡人及電話：[redacted]

出席者：國籍航空公司、國防部空軍司令部、飛航服務總臺、本局飛航標準組、航站管理小組、飛航管制組

列席者：

副本：

備註：

一、響應環保，參加人員請自備環保杯。

二、出示本開會通知單可於會議當日在臺北國際航空站停車場免費停車 1 次。

依分層負責規定授權單位主管決行

儀航程序轉換至 PANS-OPS 差異研討

一、議程

（一） 主席致詞

（二） 主辦單位報告

（三） 主辦單位簡報

1. 規範差異

2. 四機場儀航程序差異比較

3. 其他差異

（四） 議題討論

（五） 臨時動議

（六） 結論

二、參考資料

(一)、因規範不同產生之差異

差異	TERPS	PANS-OPS	因應
決定高度（DA）、最低下降高度（MDA）改為障礙物間隔高度（Obstacle Clearance Altitude, OCA）	1. 精確進場為 DA/DH；非精確進場為 MDA/HAT（MDH）。 2. 精確進場之 MDA 不論 CAT A 至 D 均相同。	1. 僅考量最低障礙物間隔（MOC, Minimum Obstacle Clearance）以訂定 OCA/H。 2. 精確進場程序之 OCA/H 各進場類別不相同。	依據 Annex 6 及「航空器飛航作業管理規則」，航空器使用人應考量各項情形，訂定其飛航各機場之最低飛航限度（如 DA/DH、MDA/MDH）。
能見度標準依 Doc9365（Manual of All-Weather Operations）制定	1. 能見度標準原則上依 HAT 對照相關表格決定之。 2. 再依進場燈型式減縮能見度標準。	1. 能見度標準原則上依 OCH/MDH 對照相關表格決定之。 2. 依表格決定之能見度標準為具有 full facility 進場燈型式，如為 intermediate facility 則增加 400 公尺，如僅具有 basic facility 或無進場燈則增加 800 公尺。	民航局將依 OCH 訂頒能見度標準； 航空公司則依其自訂之 DH、MDH 決定能見度標準，惟不可低於民航局所訂標準。
進場燈分類	1. 精確進場：2400 呎（732 公尺） 2. 非精確進場：1400 呎（427 公尺）	1. full facility：包括第 I 類精確進場燈系統（≧740 公尺）、跑道邊燈、跑道頭燈、跑道末端燈、跑道標線。 2. intermediate facility：包括高亮度簡式進場燈系統（≧420 公尺）、跑道邊燈、跑道頭燈、跑道末端燈、跑道標線。 3. basic facility：包括	進場燈系統不足 740 公尺則能見度標準增加 400 公尺；不足 420 公尺則能見度標準增加 800 公尺。

Appendix 1-7 AIC 02/10

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REPUBLIC OF CHINA
Civil Aeronautics Administration
Air Traffic Services Division
No. 340 Dunhua N.Road,
Taipei, 105, Taiwan

AIC
02/10
13 AUG 2010

臺北飛航情報區儀航程序轉換至 PANS-OPS

臺北飛航情報區儀器飛航程序將由現行依照美國聯邦航空總署 8260.3 號命令（TERPS）訂定之程序，轉換至依國際民航組織 8168 號文件（PANS-OPS）訂定之程序。上述轉換過程將分階段實施，臺灣桃園國際機場 (RCTP)、高雄國際機場 (RCKH) 及臺北 / 松山機場 (RCSS) 之儀器飛航程序將於 2010 年內轉換；預計全部轉換過程將於 2011 年底完成。

轉換前後重要變更如下：

1. 一般

a. 進場程序頒布障礙物間隔高度 / 實際高度（Obstacle Clearance Altitude/Height, OCA/H）；取代決定高度 / 實際高度（DA/H）、最低下降高度（MDA）。

i. OCA：以平均海平面高度爲基準。
ii. OCH：

- 精確進場及具垂直導引進場程序：以跑道頭標高爲基準。
- 非精確進場：以機場標高爲基準；但跑道頭標高低於機場標高 7 呎以上者，以跑道頭標高爲基準。
- 繞場進場：以機場標高爲基準。

b. 能見度標準 1500 公尺 (含) 以下將一併頒布跑道視程（RVR）標準。

c. 爬升 / 下降梯度以呎 / 浬 (ft/NM) 及百分比 (%) 表示。

d. 繞場進場區域之半徑（如下表）：

進場類別	TERPS 繞場半徑	PANS-OPS 繞場速限	PANS-OPS 繞場半徑
A	1.3 浬	100KT	1.7 浬
B	1.5 浬	135KT	2.7 浬
C	1.7 浬	180KT	4.2 浬
D	2.3 浬	205KT	5.3 浬

(註 : PANS-OPS 繞場半徑以機場標高 1000FT MSL 爲例)

2. 傳統程序

a. 傳統進場程序名稱以提供最後進場階段方向導引之助航設施命名，其他助航設施則標示「xxx required」。（如 NDB/DME-B 修改爲 NDB-B 並註明「DME required」）

b. 信標台（包括外信標台、中信標台及內信標台）撤除，其功能以測距儀取代。

3. 區域航行 (RNAV) 程序

a. 區域航行離場程序 (SIDs) 及到場程序 (STARs) 依性能導航規範 (PBN) 製訂爲 RNAV 1 程序。機載導航裝備須具備 GNSS。DME/DME 或 DME/DME/IRU 導航裝備雖可使用，然而本區並未驗證 DME/DME 涵蓋情況。

b. 現有區域航行進場程序（RNAV(GNSS)）增加以氣壓垂直導航 (Baro-VNAV) 之具垂直導引進場程序 (APV)，其水平導引係由 GNSS 取得，其垂直導引係由機載裝備之氣壓高度表資訊產生。

c. 氣壓垂直導航進場程序係附加於區域航行進場程序 （RNAV(GNSS)），進場程序圖上將增加下列資訊：

- 最低溫度。當機場氣溫低於該程序指定之最低溫度時，不得實施該氣壓垂直導航進場程序（Baro-VNAV）。
- 垂直航道角度（VPA）。
- 僅適用於水平導引（LNAV）之階梯下降點（step-down fixes）。
- 非精確區域航行進場程序之障礙物間隔高度 / 實際高度以 LNAV 標示。
- 氣壓垂直導航區域航行進場程序之障礙物間隔高度 / 實際高度以 LNAV/VNAV 標示。

參考文件

. Doc 8168 - Procedures for Air Navigation Services - Aircraft Operations

. Doc 9365 - Manual of All-Weather Operations

. Doc 9613 - Performance Based Navigation Manual

. Annex 4 - Aeronautical Charts

- 結束 -

V. Attachment List

No	Item
1-1	EGPWS simulator session video file
1-2	GE 222 performance simulator session video file
1-3	GE 222 performance with turbulence simulator session video file
1-4	TNA simulator training observation video file
1-5	TNA simulator training observations
1-6	History of TNA line observation flights
1-7	TNA ATR Standard Operation Procedure (SOP)
1-8	TNA ATR Flight Crew Training Manual (FCTM)
1-9	TNA Flight Operations Manual (FOM)
1-10	ATR72 Flight Crew Operating Manual (FCOM)
1-11	ATR Flight Crew Training Manual (FCTM)
1-12	TNA Flight Training Management Manual (FTMM)
1-13	The ALAR Briefing Notes
1-14	TNA Operations Specification
1-15	CAA official interview notes (Chinese and English)
1-16	TNA QAR data
1-17	TNA Letter of Compliance
1-18	ATR FFS Trial
1-19	Minutes of meeting ASC BEA ATR November 4th to 7th, Toulouse
1-20	TNA flight crew interview notes
1-21	CAA post accident RCQC VOR RWY 20 flight inspection