Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

SERIOUS INCIDENT

ATR 72-201, EI-REH
Approach to Kerry Airport
19 December 2011

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13[1] to the Convention on International Civil Aviation, Regulation (EU) No 996/2010[2] and Statutory Instrument No. 460 of 2009[3], safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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[1] **Annex 13**: International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.
[2] **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.
[3] **Statutory Instrument (SI) No. 460 of 2009**: Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.

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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents on 19 December 2011, appointed Mr Paddy Judge as the Investigator-in-Charge to carry out an Investigation into this Serious Incident and prepare a Report.

Aircraft Type and Registration:	AVIONS DE TRANSPORT REGIONAL - ATR 72-201, EI-REH	
No. and Type of Engines:	2 x Pratt & Whitney 124 B	
Aircraft Serial Number:	260	
Year of Manufacture:	1990	
Date and Time (UTC)[4]:	19 December 2011 @ 11.49 hrs	
Location:	Approach to Runway 26 at Kerry Airport (EIKY)	
Type of Operation:	Commercial Air Transport/Scheduled /Passenger	
Persons on Board:	Crew - 4	Passengers - 13
Injuries:	Crew - Nil	Passengers - Nil
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence (ATPL) issued by the Irish Aviation Authority (IAA)	
Commander's Details:	Male, aged 44 years	
Commander's Flying Experience:	6,998 hours, of which 4,816 were on type	
Notification Source:	Shannon ATC	
Information Source:	AAIU Report Form submitted by the Commander AAIU Field Investigation	

[4] **UTC:** Coordinated Universal Time, equivalent to local time on the date of the occurrence.

SYNOPSIS

While the aircraft was conducting an Instrument Landing System (ILS) approach to Runway (RWY) 26 at EIKY with the autopilot engaged, difficulty was experienced in following the glideslope and the aircraft descended below the glide path. As the aircraft passed over a ridge on the approach the Enhanced Ground Proximity Warning System[5] (EGPWS) activated and a go-around was initiated. Following this, a non-precision approach was flown which resulted in a successful landing. During that approach similar problems with the glideslope were experienced.

Subsequent examination by the Operator found that the unstable reception of the ILS glideslope signal was caused by a missing reflective strip from the inside of the aircraft's radome which had been recently repaired.

1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft, an ATR 72, departed Dublin Airport (EIDW) on the morning of 19 December 2011 at 11.06 hrs with EIKY as its destination. The Flight Crew comprised a training captain (Commander) and a Captain, who was being line checked by the Commander. After departure from EIDW the aircraft climbed to its cruising altitude of Flight Level (FL) 180 and later descended towards EIKY for an ILS approach to RWY 26.

The Flight Crew reported that the aircraft had problems maintaining the glide path following interception of the ILS with the autopilot engaged and that it later pitched down with a high rate of descent. The EGPWS activated and a go-around was conducted. A second approach was then commenced with similar glide path problems. The approach was continued as a non-precision approach and the aircraft landed at 12.06 hrs without further incident.

1.2 Pilot Interviews

1.2.1 Commander

The Commander stated that he was the Pilot Flying (PF), though flying from the right hand seat at the time of the occurrence. The other pilot on the aircraft (hereinafter referred to as the Captain) was returning to line flying after a short break and Operator procedures required retraining over eight sectors. The first four sectors were training flights and the next four were line checks. The four training sectors had already been completed, three on the previous day and one that morning with the Captain acting as PF.

[5] **EGPWS:** Enhanced Ground Proximity Warning System provides flight crew with a representation of the terrain near the aircraft by comparing the current position, derived from a Global Positioning System (GPS), with a terrain database for that location. The system also issues cautions if the aircraft is closing with terrain and warnings, if the terrain is seen to be a threat to the safety of the aircraft.

For the next four line check sectors the Captain was required to act as PF on two sectors and as Pilot Monitoring (PM)[6] on the other two. During the occurrence flight the Captain was acting as PM from the left hand seat.

The PF stated that they departed EIDW on a Standard Instrument Departure (SID) and shortly afterwards were cleared by ATC directly to INRAD[7]. Although their ATC flight plan was filed for FL160 they received approval to climb to FL180 in the interests of fuel efficiency. The autopilot was engaged throughout. They requested and were cleared by ATC Shannon to descend towards EIKY, their intention being a steady 3° descent profile to the airport. They were handed over to Kerry Tower about 5 nautical miles (NM) before INRAD. He believed that they were then cleared to descend to 4,000 ft altitude and to call when established on the localiser. The PF armed the Approach mode and believed that they were descending with a rate of descent of about 1,200 ft/min at that time. His recollection was that when they were at about 4,500 ft altitude at a speed of about 210 kts they entered the LOC* mode, indicating that the aircraft's automatic flight control system (AFCS[8]) had entered localiser capture mode. They became established on the localiser at about 15 NM from EIKY, just below the glideslope on a normal descent profile. Shortly afterwards the AFCS entered GS* mode, indicating that it had entered glideslope capture.

He commented that the glideslope appeared to be a little unstable, though he expected it to stabilise closer to the airport, but the aircraft was tracking the localiser properly. Having captured the glideslope, the aircraft initially went above it and then descended back through the glideslope slightly. It then chased the glideslope, he believed possibly twice, and both pilots commented on the poor performance of the autopilot in capturing the glideslope. He recalled that at the time the PM remarked that the aircraft was close to one dot high on the glideslope, but that they were still in glideslope capture mode and the aircraft was now regaining the slope. The PF stated that again the aircraft did not stabilise on the glideslope, whose display was moving more than would usually be expected. He then noticed the aircraft pitching down to a vertical speed of about 2,000 ft/min and commented to the PM on the high rate of descent, wondering if they had encountered a tailwind on the approach but still expecting the aircraft to correct for this. At that time he believed that they were approximately 9 NM (DME[9]) from EIKY. He recalled that shortly afterwards the EGPWS 'CAUTION TERRAIN' activated followed by the warning 'TERRAIN AHEAD'. He stated that by then he had already disconnected the autopilot and called "Go-around" from, he believed, about 2,000 ft and 7 NM.

The full missed approach procedure was then flown with a climb to 3,000 ft and the aircraft was positioned for another ILS approach. They decided to conduct this second approach using a full ILS procedure and that if the glideslope should act the same way, they would revert to a non-precision localiser/DME approach with standard height checks against distance and they briefed accordingly.

[6] **PM:** Pilot Monitoring is also known as Pilot Not Flying (PNF).
[7] **INRAD:** A waypoint at 14 nm on the ILS approach to RWY 26 at EIKY.
[8] **AFCS:** The ATR automatic flight control system consists of the flight director and autopilot systems.
[9] **DME:** Distance Measuring Equipment.

He stated that the second approach was commenced with the aircraft configured as per normal procedures and the aircraft became established on the localiser. Although the glideslope was captured from below, the aircraft went through it and then pitched down with an excessive rate of descent. As the glideslope was *'twitching*' it soon became apparent that the autopilot was not going to maintain it and that the aircraft was "*chasing the glideslope*". The PF stated that they discontinued the ILS approach and continued with a localiser/DME approach as briefed. They became visual at about 700 ft and landed.

He had flown into EIKY many times previously and was quite familiar with the airport. He stated that he was not expecting the aircraft to react the way it did. Since the AFCS was in GS* mode he expected the system to sort itself out and was surprised that the end result was an EGPWS activation.

1.2.2 Captain

The Captain informed the Investigation that at the time of the occurrence he was acting as PM from the left hand seat. They had flown from EIKY to EIDW, to the Isle of Man, back to EIDW and then to EIKY where the occurrence happened. He recalled that during the ILS approach to RWY 26 the aircraft became established on the localiser at approximately 14 NM. It subsequently entered GS* mode normally. At approximately 9 NM both pilots observed the aircraft struggling to maintain the glideslope. The aircraft became high with respect to the glideslope and he observed to the PF that it was getting close to one dot deflection. He then noticed the aircraft pitching down with a resulting high descent rate in excess of 2,000 ft/min. Quickly thereafter an EGPWS 'CAUTION TERRAIN' followed. He glanced at the glideslope which indicated that they were still high. He thought that the caution was due to the high descent rate. They then got a "PULL UP" Terrain Warning. He said that by that stage the PF had disconnected the autopilot and had already pitched the aircraft up to +5°. The PF called a go-around which was then completed.

Shortly afterwards, EIKY Tower requested the reason for the go-around and he advised that this was due to a glideslope issue that resulted in an EGPWS alert and a mandatory go-around. He stated that on the second approach the glideslope again behaved erratically, giving incorrect indications, and that they reverted to a non-precision localiser/DME approach from which they landed.

The Minimum Safe Altitudes (MSAs) for EIKY were briefed in advance of the approach. He said that the charts they used did not show spot heights (**Appendix A**). He had not cross-checked the aircraft's altitude versus DME distances and believed that during the approach he was focussed on the aberrant glideslope and the descent rate and had not noticed the reduced height over the ground.

He observed that during their earlier approach into EIDW they had received a CAT II invalid warning but had not considered that significant at the time. On their later return from EIKY to EIDW an ILS approach was flown without any glideslope issues. They were met by technical staff on arrival at EIDW who checked the aircraft's ILS system and informed them that it was serviceable.

1.3 Air Traffic Control (ATC)

While en-route the aircraft had been in contact with Shannon ATC which transferred it to EIKY Tower frequency as it approached EIKY. Whereas Shannon ATC uses radar to control air traffic, EIKY Tower operates a procedural control service which requires aircraft to make mandatory reports to ATC providing information on their position and altitude.

The EIKY Tower recording showed that, on initial contact, EIKY Tower cleared the aircraft to descend to 3,500 ft and to establish on the RWY 26 ILS. At 11.47:04 hrs the aircraft advised EIKY Tower that it was established on the RWY 26 ILS localiser at 14 NM DME. ATC cleared it to descend to 3,000 ft and for an ILS approach to RWY 26, requesting that it report at 4 NM. At 11.48:41 hrs the aircraft advised that it was going around.

At 11.48:46 hrs the Shannon ATC radar controller observed the aircraft on radar at 2,000 ft altitude and 9 NM from EIKY when the Minimum Safe Altitude Warning (MSAW) system activated. He contacted EIKY Tower by telephone to advise that the aircraft was too low.

At 11.49:08 hrs the aircraft, in a response to an ATC query, advised that they had an issue with the glide path and that they had received a terrain warning which required a mandatory go-around in IMC[10] conditions. ATC then cleared EI-REH to return overhead the field and carry out a procedural approach as published.

The ATC radar recording showed that the aircraft reached a minimum altitude of 2,000 ft during the occurrence at 11.49 hrs, following which it climbed.

1.4 Flight Data Recorder (FDR)

FDR data was downloaded and examined. It did not record aircraft position information. The downloaded data showed that the minimum altitude recorded during the occurrence was 1,955 ft. Six seconds beforehand, the aircraft had begun to pitch up, eventually reaching a pitch angle of +4.2° following which it climbed to 3,000 ft. During the pitch up, the FDR recorded a full scale deflection of the ILS glideslope from fly up to fly down.

1.5 Enhanced Ground Proximity Warning System

EGPWS integrates positional information from GPS[11] with three dimensional terrain data, looking ahead of and beneath the aircraft to identify and warn of potential collisions with terrain. It also logs historical data for a period about the event in the non-volatile flash memory. The 30 seconds of EGPWS data for this event was recovered and showed that during the occurrence the glideslope signal was irregular.

The data showed that the EGPWS issued an advisory Terrain Caution at position N52.23664°, W009.25161° followed two seconds later by a Terrain Warning at position N52.23616°, W009.25441°.

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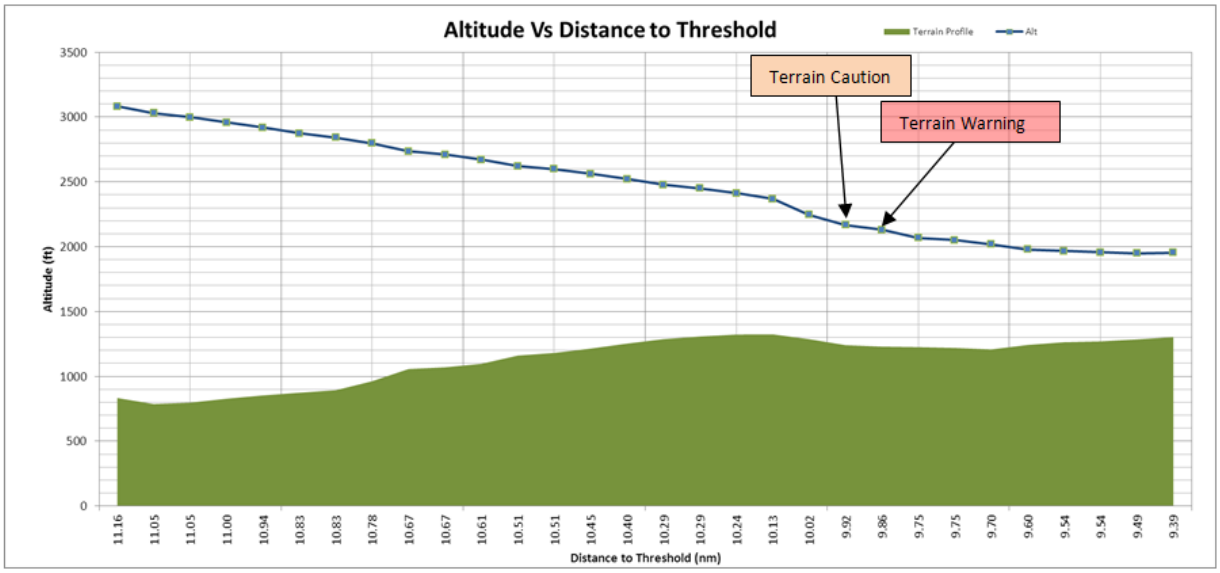
[10] **IMC:** Instrument Meteorological Conditions at the time of the event were meteorological conditions where the aircraft was in cloud and/or not in visual contact with the ground and/or with horizontal visibility less than 5,000 metres (ICAO Annex 2).

[11] **GPS:** Global Positioning System.

The Terrain Caution activated as the aircraft was descending through an altitude of 2,246 ft, at a Radio Altimeter (RADALT) height of 959 ft above the ground and at a distance of 10.02 NM from the threshold of RWY 26. At that time the rate of descent was 2,400 ft/min. The Terrain Warning occurred at an altitude of 2,100 ft when the Glideslope Deviation was showing a valid signal but which incorrectly showed that the aircraft was between 1 and 1.25 dots high.

Graphic No. 1 shows the altitude of the aircraft (dotted line) versus the height of the local terrain for the period the EGPWS recorded.



Graphic No. 1: Altitude versus Distance to threshold of RWY 26

The minimum RADALT height recorded by the EGPWS was 651 ft shortly after the aircraft became level at 9.39 NM from the threshold of RWY 26.

During the second approach the EGPWS also recorded a Mode 5 glideslope alert at 5 NM from the threshold of RWY 26. This showed that the glideslope, which at the time was reading 0.4 dot fly up, went to 3.3 dots fly up in 2 seconds and then became invalid.

1.6 Instrument Landing System (ILS) EIKY RWY 26

Glide Path monitors provide a warning in the EIKY Tower and shut down the glide path system if any of the following conditions persist:

- A shift in the Glide Path angle of greater than minus 0.075°.
- A significant reduction in the output power.
- A change in the width of the Glide Path sector (displacement sensitivity).
- A reduction of DDM[12] to less than 0.175 below the Glide Path sector.

[12] **DDM:** Difference in the Depth of Modulation.

Following the occurrence the ILS glideslope records for RWY 26 at EIKY were examined and no abnormalities were found. The duty ATCO at EIKY confirmed that the ILS was monitoring as "Normal" at the time of the incident and no issues were reported by other aircraft using ILS 26 that day at EIKY, including the aircraft immediately ahead of and behind EI-REH.

The Aeronautical Information Publications (AIP) Ireland contains EIKY AD 2.24-7, the Instrument Approach Chart for EIKY (**Appendix B**). This shows ground spot heights on the approach, the highest being 1,679 ft, slightly west of VENUX.

1.7 EI-REH Maintenance

The aircraft was certified for flight and no prior operational or technical issues were reported to the Investigation. A functional test (JIC 34-36-00 FUT10000) of the ILS system was carried out later on the day of the occurrence in accordance with the Aircraft Maintenance Manual (AMM). This found that the ILS system was operating correctly and the aircraft was released to service with a request that a simulated CAT II[13] approach be carried out. This was completed successfully the following day, the 20 December 2011. Further investigation into the erratic glideslope called for an on-going series of functional tests, replacement of electronic units and wiring checks (Work Order 1038833, dated 23 December 2011). This also included a requirement to "….*check radome reflective strip for any obvious defects*".

On the 29 December 2011 pilots reported '*Glideslope Fluctuations Up/Down One Dot, seems to be happening on Box 1 and Box 2'*. Both No 1 and 2 VOR[14]/ILS receivers were replaced and the aircraft was again released to service.

During further troubleshooting early on the 30 December 2011, the glideslope antenna was removed, tested and found serviceable and a functional test on the Radio Altimeter was also found satisfactory.

After a flight later that day the radome was removed. The technical report states '…..*the radome currently fitted is found to be without metallic strip for ILS beam concentration, which as per ATR communication email is a likely cause for glideslope problem'.*

The metallic strip, a 'Glideslope Antenna Deflector', Part Number (P/N) S53975000-204, is shown installed on a serviceable radome in **Photo No. 1.** It is used to concentrate the glideslope beam towards the glideslope antenna. The strip is 335 mm long by 12.5 mm wide and is attached to the radome by adhesive. The ILS on the aircraft is considered unserviceable if the strip is missing.

[13] **CAT II:** Category II ILS. A precision instrument approach and landing operation.
[14] **VOR:** VHF Omni-Directional Radio Range.

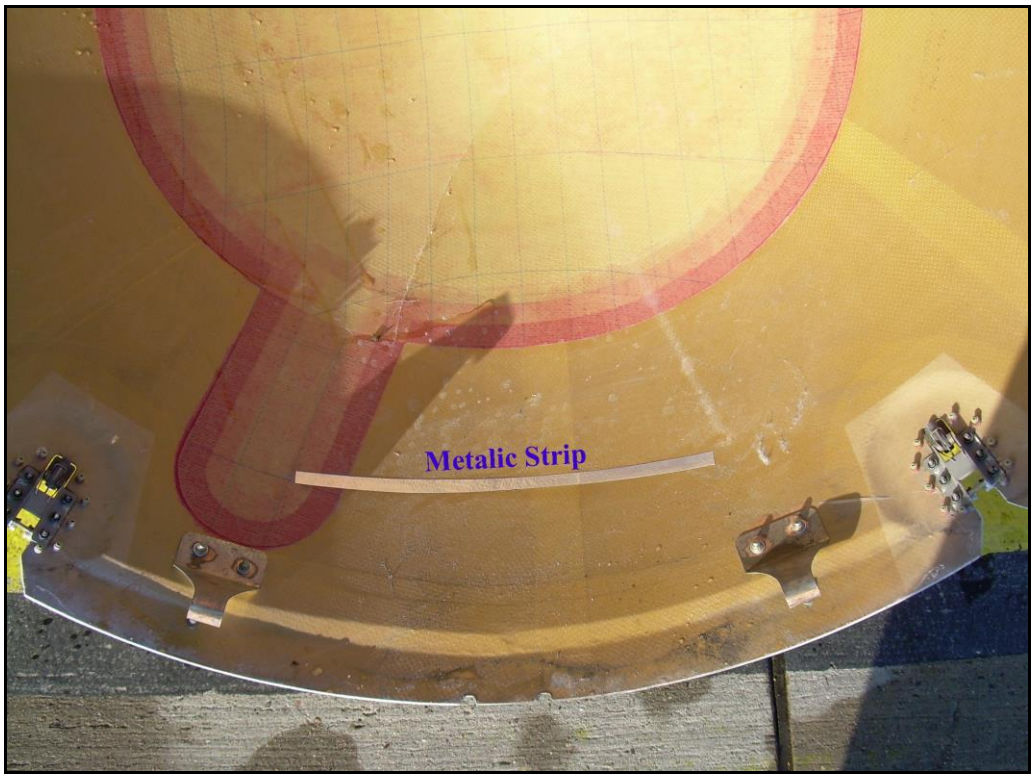


Photo No. 1: Interior of Radome with metallic strip installed.

9 A different radome was then fitted and the aircraft was returned to service. Following a functional test of the CAT II ILS the following day, the aircraft was cleared for CAT II operations and no further ILS glideslope problems were reported.

1.8 Radome Records

A review of the aircraft's records showed that the radome (P/N S539750000800) was last removed from the aircraft during a base maintenance check at an approved facility in Guernsey. The base maintenance check was completed on the 26 November 2011 when the "Final Certificate of Release to Service following Base Maintenance" was issued. During the check the radome bonding was found to be '*out of limits*'. In accordance with SRM[15] 51-21-29 the radome was then stripped, sanded and repainted and subsequently refitted. The facility's technician who repaired the radome could not confirm if the Glideslope Antenna Deflector was attached to the radome before or after it was repaired.

The ATR AMM JIC 53-91-21 RAI 10000, Radome Removal and Installation, step 3 states:

003 GENERAL VISUAL INSPECTION:

1. Verify Correct Installation of the Glideslope Antenna Deflector & Check for General Condition.

[15] **SRM:** Structural Repair Manual.

No evidence was found that this check had been carried out. The Operator subsequently inspected its fleet and found that each of its other ATR aircraft had the Glideslope Antenna Deflector installed.

The maintenance facility also issued a Quality Alert to ensure that its technicians were aware that it is possible that the Glideslope Antenna Deflector, which has a self-adhesive backing, may become detached during overhaul and that it is the responsibility of the certifying engineer to ensure the serviceability of the component subsequent to maintenance.

1.9 Meteorological Information

The weather conditions at that time, as reported by EIKY, were wind 290°/08 kts, visibility 10 km+, cloud broken at 500 ft, QNH 1013 hPa.

1.10 Aircraft Information

EI-REH is an ATR 72 which is a twin-engine turboprop short-haul regional airliner built by the French-Italian aircraft manufacturer ATR. It seats up to 78 passengers in a single aisle configuration and is operated by a two pilot crew. The Operator has used various ATR 42/72 variants over the past 10 years.

At the time of the occurrence the aircraft's weight was 16,150 kg, the Maximum Landing Weight being 21,350 kg. It was in trim at 23.9% MAC[16], the limits for its weight being 18.3% – 31.2%.

1.11 Personnel Information

1.11.1 Commander

Personal Details:	Male, aged 44 years
Licence:	IAA ATPL - Valid
Last Periodic Check:	25 September 2011
Medical Certificate:	30 August 2011

Flying Experience

Total All Types:	6,998 hours
Total on Type:	4,816 hours
Total on Type P1:	2,981 hours
Last 90 Days:	156 hours
Last 28 Days:	52 hours
Last 24 Hrs:	8 hours

[16] **MAC:** Mean Aerodynamic Chord.

Duty Time

Duty Time up to Occurrence	5 hours
Rest Period Prior to Duty	10 hours 41 minutes

1.11.2 Captain

Personal Details:	Male, aged 37 years
Licence:	UK CAA ATPL - Valid
Last Periodic Check:	30 November 2011
Medical Certificate:	12 April 2011

Flying Experience

Total All Types:	3,344 hours
Total on Type:	3,144 hours
Total on Type P1:	908 hours
Last 90 Days:	146 hours
Last 28 Days:	26 hours
Last 24 Hrs:	2 hours

Duty Time

Duty Time up to Occurrence:	5 hours
Rest Period Prior to Duty:	10 hours 41 minutes

1.12 Previous Serious Incident at EIKY

EIKY Tower does not have a radar display and thus uses procedural control to ensure the safe control of aircraft within its area. Consequently, aircraft are required to advise the ATC controller by VHF radio of their position so that traffic can be coordinated.

An AAIU investigation (AAIU Synoptic Report No: 2010-012) into a serious incident at EIKY in 2009 found that there was a serious loss of navigational and situational awareness while an aircraft was attempting to return to EIKY following a windshield fracture encountered shortly after take-off. A contributory factor was that the situational awareness of the controller in Kerry Tower was compromised by the lack of direct radar information.

Accordingly, that Investigation issued a Safety Recommendation that:

*The licensee of Kerry Airport, in conjunction with the Irish Aviation Authority, should review the provision of radar information to support the air traffic control service provided by Kerry ATS unit **(IRLD2010016)**.*

The IAA informed the Investigation that EIKY had purchased a system, the installation of which commenced in December 2013. It was estimated that the hardware installation (displays, lines etc.) and training for ATC personnel at EIKY would be completed in early 2014. It was planned that the Air Traffic Monitor would be commissioned into operational service by the end of May 2014, subject to the regulatory acceptance of the associated safety case.

1.13 Operator Procedures

Regarding the aircraft's flight crew composition, the Operator informed the Investigation that it was not its practice to roster two captains to fly together. The only situation where that arose was when the right hand seat occupant was a Training Captain, ordinary line captains are not right seat qualified.

Having examined the factual information the Investigation advised the Operator that there may have been an issue regarding MSA awareness among the Operator's pilots. Following a review of procedures the Operator issued a Flight Crew Instruction (FCI 14/07) to pilots amending the procedures in its Operations Manual Part B, Section 2.3.5, Altitude Checks. This FCI was approved by the IAA on the 19 May 2014 and implemented new mandatory callouts when passing through the MSA, whether climbing or descending.

2. ANALYSIS

2.1 General

The licences and medical certificates of the Flight Crew were valid. They were appropriately qualified and at the time a line check was being conducted in accordance with the Operator's procedures. The aircraft's documentation stated that it was airworthy and that it did not have any relevant defects. The approach was conducted in IMC conditions during which unstable glideslope reception resulted in a descent by the aircraft below the correct glide path to such an extent that the EGPWS warning system activated. The incorrect glideslope indication was due to a missing Glideslope Antenna Deflector which led to the aircraft descending below the glide path and the MSA. Operationally, this descent should have been noticed by the Flight Crew before the EGPWS safety net activated. Furthermore, the local Tower Controller, who was controlling the traffic, was unable to see or monitor that descent, although his ATC colleague at a distance in Shannon could view it on radar.

2.2 Glideslope

A functional test of the aircraft's ILS following this occurrence was satisfactory and no defect was found. Nevertheless, following a subsequent report of erratic glideslope, troubleshooting of the ILS system was conducted in accordance with the Manufacturer's guidance. This eventually found that the Glideslope Antenna Deflector, which should have been attached to the inside of the radome, was missing. This aluminium foil strip concentrates the ILS glideslope signal and, when missing, the signal received by the ILS receiver via its antenna is attenuated (weakened). In other weather conditions and at some airports the glideslope signal was evidently strong enough to allow CAT II approaches to be successfully flown under the control of the AFCS with the autopilot engaged.

This was not the situation at EIKY during this approach where the glideslope signal would have been further attenuated by the 9 NM distance at which the event occurred.

It was not possible to determine where or when the metallic strip detached from the radome. However, it appears likely that this may have happened during repair when the radome was stripped, sanded, repainted and refitted to the aircraft without a check for the presence of the Glideslope Antenna Deflector. As there was no evidence of ILS problems on the aircraft prior to maintenance on the radome, the Investigation considers this the most likely scenario.

Following discovery that the Glideslope Antenna Deflector was missing, a subsequent check by the Operator found that the Glideslope Antenna Deflector was present on all other radomes in its ATR fleet.

The Investigation is satisfied that this appears to be a one-off event and that the procedures put in place by the maintenance facility, following determination of the cause of the ILS glideslope attenuation, should be sufficient to prevent the future release of a radome from maintenance without a serviceable Glideslope Antenna Deflector. Consequently, no Safety Recommendation is considered necessary in this regard.

2.3 Operational Issues

During the approach the autopilot was used and, although the ILS glideslope was erratic, the aircraft had commenced capture. Having done so the Flight Crew reported and EGPWS data shows that the aircraft chased an unstable glideslope. Although the PF stated that he expected the aircraft to stabilise on the glideslope, this did not happen as the AFCS chased the glideslope and eventually the aircraft pitched down in accordance with the unstable signal received.

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The Flight Crew stated that the briefing for the approach included safety heights as depicted in the chart they used. The chart in **Appendix A** (an extract from which is shown in **Figure No. 1** below) shows grey areas which are the minimum altitudes that should be maintained until the appropriate DME distance is reached.

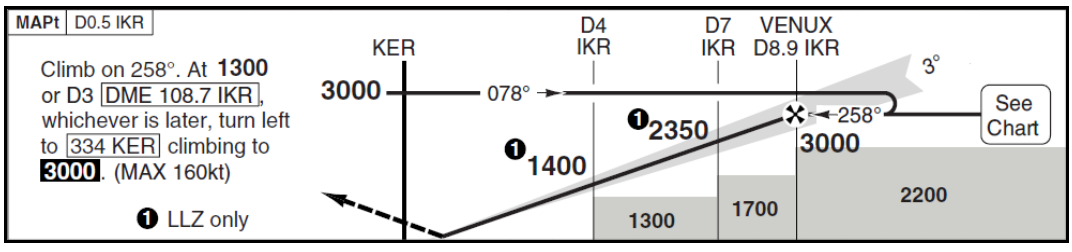

Figure No. 1: Extract from the Approach Chart in Appendix A.

The ILS approach procedure requires that VENUX, at 8.9 NM from the threshold of the runway, should be crossed at an altitude of 3,000 ft and a descent then commenced. Outside VENUX the safety altitude is 2,200 ft due to a ridge across the approach path.

The data shows that at a position approximately 1.1 NM before VENUX the aircraft descended through 2,246 ft and had reached a descent rate of 2,400 ft/min at which point the EGPWS activated.

In general, the ILS has proved over the years to be a very reliable guidance system which pilots can trust. Having successfully captured the localiser and glideslope, flight crew can reasonably expect that it will lead them safely towards the runway. This provides a certain amount of comfort to air transport pilots as almost all of their flights conclude with flying an ILS approach. In addition, modern aircraft design and technology generally provide warnings to the pilot if either the ILS ground installation or the aircraft equipment is defective. Consequently, an erratic ILS is an unusual event and pilots can be lulled into a certain amount of complacency due to its normal reliable performance particularly when no warnings are shown, as in this case.

Good situational awareness requires that the pilot should have an on-going accurate three-dimensional overview of what the aircraft is doing, where it is and where it is going, particularly regarding the horizontal and vertical flight path of an approach in IMC conditions. Attention should not become focussed on one particular issue (which is known as "attention tunnelling") to the detriment of overall situational awareness, specifically the spatial environment. As the MSA depicted on the chart at VENUX was 3,000 ft the aircraft should not have descended below that until past VENUX.

It appears that the Flight Crew became distracted by the aberrant glideslope reception and its effect on autopilot performance to the detriment of monitoring the aircraft's position and flight path. Moreover, the vertical flight path was not cross-checked by comparing altitude with the distance to the runway, as shown by the DME.

An additional factor that should be considered is the crew resource management associated with the non-normal flight crew composition, since the flight was a line check. Both pilots were captains and, whereas the Captain in the left hand seat was acting commander, the formal command rested with the training captain (the Commander) flying from what would normally be the co-pilot's or first officer's position. In general it is recognised that an appropriate cross cockpit experience and authority gradient leads to better crew co-ordination. In part this is because the authority and leadership position is clearly defined and recognised. Consequently, normal practice is to roster captains with less experienced co-pilots in the right hand seat.

Due to the requirements of a line check the Captain was the acting commander whereas the authority resided in the Commander, who was assessing the Captain. It is possible that when the PF became pre-occupied with the performance of the autopilot and the glideslope, the arousal levels of the PM were insufficient to generate concern regarding terrain clearance.

As both pilots involved were quite experienced the Investigation considered that there may have been an issue regarding MSA awareness among the Operator's pilots and advised the Operator accordingly. Following this the Operator issued an FCI to its pilots implementing new procedural callouts when passing the MSA. In view of the action taken, the Investigation considers that a Safety Recommendation is not necessary in this regard.

2.4 ATC Operational Issues

EIKY Tower does not have a radar display and accordingly uses procedural control to manage its local air traffic. During procedural control flight crews are required to provide accurate position and altitude reports to ATC which in turn is relying on pilots to provide this information. Other than the position reports provided by the aircraft, the Tower Controller had no direct knowledge of the exact position and altitude of the aircraft. Having cleared the aircraft for approach, the Controller relied on the aircraft to monitor its own terrain clearance. Although there is a radar display at Shannon, which has a terrain clearance warning system, this requires that the Shannon controller calls the EIKY Tower controller by phone to advise him that the MSAW has activated. In this case that call was made shortly after the aircraft's own EGPWS warning had activated and the aircraft had commenced a go-around. Nevertheless, should the aircraft involved not be equipped with EGPWS vital seconds may be lost during an occurrence.

In addition, as ATC is responsible for the utilisation of its airspace, the lack of a radar display is an impediment to the efficient control of air traffic. In addition, the provision of a radar display would provide an additional safety barrier by assisting controllers in identifying situations in a timely manner. A previous Safety Recommendation was issued by the AAIU in 2010 concerning the provision of radar information to support the air traffic control service in EIKY Tower. The Investigation has been informed that a radar display has been installed and that it is in the process of being commissioned. Therefore, the Investigation considers that a Safety Recommendation is not required regarding this matter.

3. CONCLUSIONS

(a) Findings

1. The Flight Crew were properly licensed with valid medicals.

2. The aircraft conducted two approaches at EIKY where IMC conditions prevailed.

3. The aircraft encountered unstable glideslope reception during its first ILS approach to RWY 26 at EIKY.

4. When the glideslope incorrectly indicated that the aircraft was high the autopilot pitched the aircraft down, reaching a descent rate of 2,400 ft/minute.

5. An EGPWS Terrain Caution activated followed immediately by a Terrain Warning and a go-around was conducted.

6. A second ILS approach was commenced but due to the unstable glideslope reception it was continued as a non-precision approach and a safe landing was made.

7. The minimum altitude recorded during the first approach was 1,922 ft at 9.39 NM from the RWY 26 threshold, the height over the ground being 651 ft.

8. The unstable glideslope reception was caused by a missing Glideslope Antenna Deflector from the aircraft's radome.

9. The Glideslope Antenna Deflector probably detached during the recent repair of the radome.

10. No check was made that the Glideslope Antenna Deflector was installed following repair of the radome.

11. The Flight Crew focussed on the apparent poor performance of the autopilot and did not adequately monitor the altitude of the aircraft vis-à-vis the distance to landing.

12. EIKY Tower was unaware of the low approach as it had no radar display.

(b) Probable Cause

The absence of a Glideslope Antenna Deflector resulted in unstable glideslope signal reception which led to the autopilot descending the aircraft below the glide path in IMC.

(c) Contributory Cause(s)

1. Ineffective monitoring and lack of situational awareness by the Flight Crew.

2. Inability of the EIKY ATC to monitor the aircraft due to lack of a radar display.

4. SAFETY RECOMMENDATIONS

This Investigation does not sustain any Safety Recommendations.

- END -

Appendix A

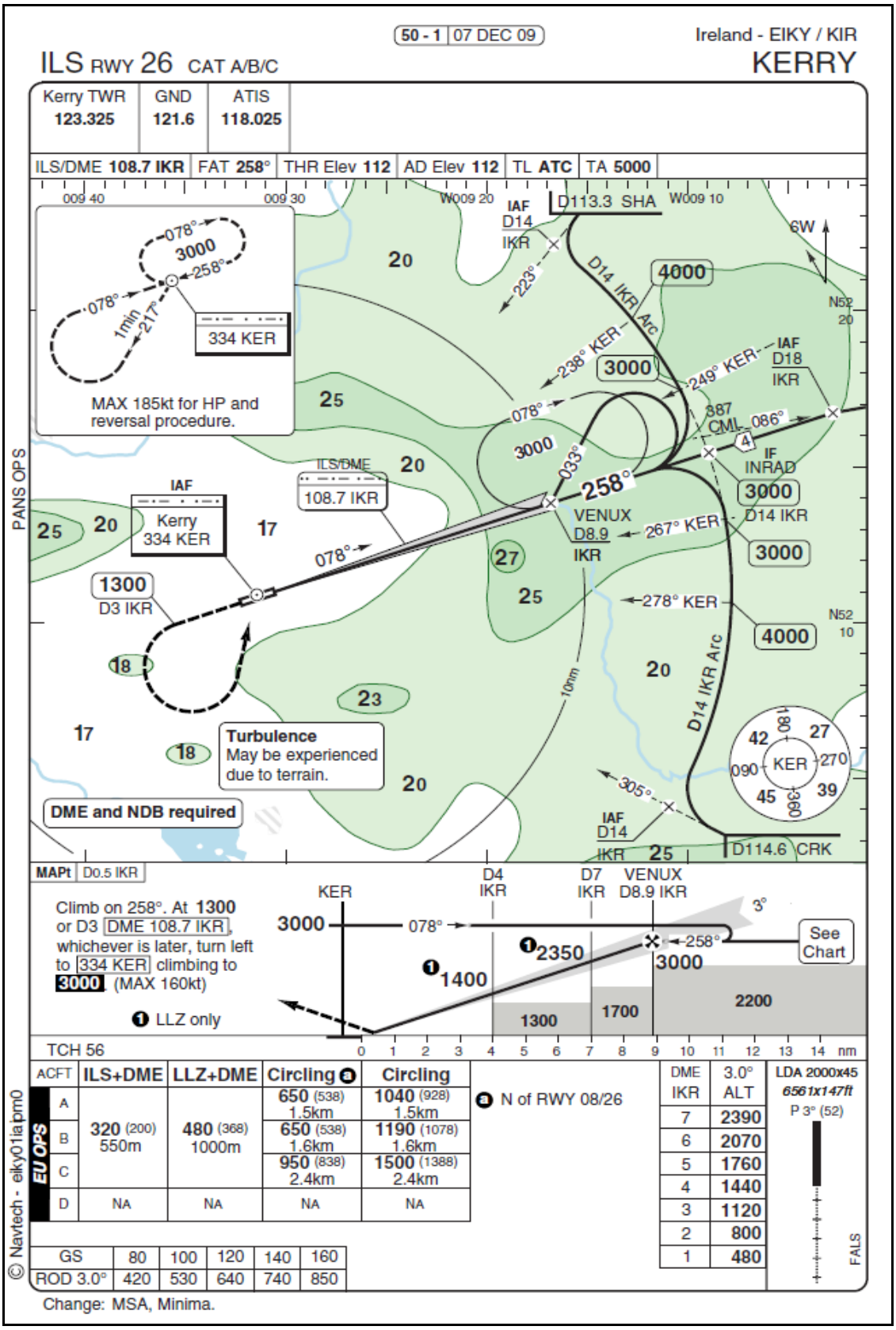

Figure 7: Navtech Approach Chart, EIKY ILS RWY 26.

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

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An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Air Accident Investigation Unit,
Department of Transport Tourism and Sport,
2nd Floor, Leeson Lane,
Dublin 2, Ireland.
Telephone: +353 1 604 1293 (24x7): or
+353 1 241 1777
Fax: +353 1 604 1514
Email: info@aaiu.ie
Web: www.aaiu.ie