International Civil Aviation Organization

WORKING PAPER

A42-WP/534
TE/206
4/9/25
(Information paper)
English only

ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

PREVENTION OF CONTROLLED FLIGHT INTO TERRAIN (CFIT) ACCIDENTS ON APPROACH

(Presented by India)

EXECUTIVE SUMMARY

Controlled Flight Into Terrain (CFIT) accounts for a disproportionate number of fatalities in aviation accidents, particularly during the approach phase. Despite global improvements in technology and training, CFIT remains a significant safety concern. This information paper analyzes international data, Indian experience, and regulatory best practices to highlight effective prevention strategies and call for further ICAO guidance.

Strategic Goals:	This information paper relates to the Strategic Goals *Every Flight is Safe and Secure.*
Financial implications:	NIL
References:	International Air Transport Aviation (IATA), Flight Safety Foundation, SKY brary, International Civil Aviation Organization (ICAO), National Transport Safety Board (NTSB), Directorate General of Civil Aviation (DGCA) and Aircraft Accident Investigation Bureau (AAIB, India). ***Note****: All the Data and Information has been consolidated from the web pages. Since there is an overlap of references the individual credits for each are not quoted.*

1. INTRODUCTION

1.1 The aircraft accidents are classified as Control Flight Into Terrain (CFIT) if it occurs with a serviceable aircraft operated by qualified pilots to handle the prevailing weather minima conditions. Aircraft is unintentionally flown into the ground, water, or an obstacle. Such accidents often occur without mechanical failures, typically stemming from pilot disorientation, navigational error, or inadequate terrain awareness.

2. DISCUSSION

2.1 Indian Experience

2.1.1 The crash of Indian Airlines A320 in 1990 at Bangalore, B737 in 1991 at Imphal were classic CFIT accidents. Runway overrun in terrain by Air India Express at Mangalore was not a classic CFIT, but it had CFIT elements of failure to go around despite warnings. 2015's two Pawan Hans crashes, fatal offshore Pawan Hans helicopter crash in 2018, AS-350 helicopter crashes in 2019. Bell and Cessna accidents in 2022 and 2024 had seen three helicopter crashes which are under investigation. Globally, CFIT have reduced in commercial aviation due to improved ground-proximity warning systems and training, but it remains a pertinent safety concern, especially in challenging environments. Often involving helicopter operations in remote or mountainous regions (e.g. Northeast India). However, challenging mountainous terrain, bad weather, non-scheduled operations in India requires vigilance and targeted safety measures in those sectors.

2.1.2 ***ATC System.*** India's ATC system has been evolving to provide similar safety nets, though nationwide implementation has been more recent. Major Indian approach control radars are equipped with safety alerting functions like Minimum Safe Altitude Warning (MSAW), and the Airports Authority of India has been working to integrate these systems. The importance of MSAW is recognized in Indian safety planning – the DGCA's 2024–2028 National Aviation Safety Plan explicitly lists implementing MSAW systems as a safety enhancement initiative. Indian ATC units at international airports do issue terrain alerts; however, historically not all smaller radar installations had this functionality.

2.1.3 Inquiries recommended enhancing pilots' GPWS training and strict adherence to stabilized approaches. The DGCA mandates terrain awareness systems in all scheduled air transport aircraft in India with a certified take-off weight >5,700 kg or carrying more than 9 passengers with a forward-looking terrain avoidance function (i.e. EGPWS). More recently, the 2022 Kedarnath helicopter crash investigation by India's AAIB recommended mandating HTAWS for commercial helicopter operations in hilly terrain which is under review by DGCA.

2.1.4 ***Terrain Awareness Equipment Mandates (GPWS/TAWS).*** One of the most direct CFIT countermeasures is onboard terrain awareness technology for commercial airline. The regulations mandate advanced Ground Proximity Warning Systems (GPWS) with terrain awareness (commonly known as EGPWS or TAWS) in commercial aircraft, but the scope and timeline of mandates differ slightly. However, DGCA has not yet mandated HTAWS equivalent to the FAA's rule for HEMS. Most Indian helicopter operations are VFR (visual flight) such as state VIP transports, offshore support, or tourism, and historically relied on operational caution more than technology. The present approach is to encourage precautionary landings in bad weather and improve pilot decision-making. The National Aviation Safety Plan 2024–2028 even notes an initiative to expand TAWS usage in helicopters and smaller aircraft.

3. GLOBAL CFIT ACCEIDNETS

3.1 IATA data reveals that 71 out of 1468 global accidents reported from 2005 to 2024 were classified as CFIT accidents. CFIT constitutes 4.83% of total accidents but resulted in 18.79% of total fatalities (1518 of 8076 fatalities). 28 out of 33 CFIT accidents were fatal. It proves that the rate and chances of fatalities in CFIT are very high among other categories of accidents. 15 out of 28 fatal and 4 out of 5 non-fatal CFIT accidents were on approach phase of flight. Hence, present paper delved into all the CFIT accidents reported globally and recommends the methods to prevent CFIT accidents on approach.

4. CFIT ACCIDENTS ON APPROACH

4.1 There were seven CFIT accidents enroute and 15 accidents on approach. A brief on all the 15 CFIT accidents on approach are briefed to understand how the situations went out of control. A CRJ-900LR crash-landed at Toronto striking the runway with a high rate of descent in 2025. An Airbus A330-300 landed 11 metres short of the runway in Amsterdam in 2023. An Airbus A320 descended below minimum safe altitude at Guadeloupe in 2022. A Boeing 777-300ER lost visual reference in bad weather after diversion and crash landed with low fuel in Indonesia. A Boeing 737-800 on an ILS approach to Paris was mishandled leading to triggering of EGPWS warning. A Boeing 787-9 approaching Hong Kong failed to capture localiser. An Australian Fokker F100 landed safely after multiple failed approaches. A Thai Airbus A350-900 conducting a night ILS approach to Frankfurt in good visual conditions descended prematurely due to waypoint input errors. A Gulfstream G550 on an offset non-precision approach to Paris made an incorrect visual transition. A DHC-6 Twin Otter (9N-AHH) crashed into rocky terrain in Nepal. The crew repeatedly entered cloud, lost situational awareness, deviated from their intended route, and failed to react to EGPWS alerts. 5 out of 15 CFIT accidents are by highly sophisticated French operators or airfields. Hence, the qualification, sophistication in technology and infrastructure doesn't stop CFIT accidents.

5. USA EXPERIENCE

5.1 Based on NTSB accident database for USA, since 2020, approximately 120 accidents have been categorized as CFIT based on ICAO definitions, almost half of them, 67 had fatal accidents. Most common phases of Flight were En Route (39) and Approach (37) phases. Surprisingly, most events were VMC weather conditions and only 29 incidents were in IMC. There were total of 115 fatalities over the years.

5.2 Additionally, the United States Helicopter Safety Team (USHST) publishes key risk factors for the industry and based on their analysis, CFIT was ranked #5 as key category of helicopter accidents in the USA between 2008-2018.

6. RECOMMENDATIONS

6.1 CFIT/EGPWS Detailed Implementation Plan

6.1.1 From the data presented, CFIT accidents continue to occur and ranked the second highest fatal accident category. However, the number of aircraft that have landed safely after EGPWS warning is growing. IATA developed a Detailed Implementation Plan (DIP) for reducing the risk of CFIT events. Following Recommendations need to be implemented to prevent CFIT accidents:

a) Ensure EGPWS Software and Terrain/Obstacle/Runway database are kept up to date.

b) Ensure GPS/GNSS is used as a position source for the EGPWS.

c) Ensure At least one pilot selects terrain display during critical phases of flight (such as climb and descent below MSA) for additional situational awareness. If weather is not a threat, then both pilots could decide to select terrain display.

d) Establish a training program to ensure flight crew are trained to respond to EGPWS alert effectively.

e) Airlines to ensure that EGPWS equipment always remains activated and serviceable.

f) Pilots and operators should promptly notify the respective authorities of the interference location and the relevant ATC if they experience GPS anomalies.

g) Consult IATA Performance assessment of pilot response guidance material (GM) and recommendations.

7. CONCLUSION

7.1 Training, Crew Resource Management (CRM) and Technology are enablers to prevent CFIT accidents in general and terrain awareness technologies, such as the EGPWS / TAWS for accident prevention during approach in particular. The simple reminders to pilots as per principles of andragogy can prevent CFIT accidents.

— END —