



# RASG-AFI Controlled Flight Into Terrain (CFIT) Workshop.

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# ICAO regulatory provisions on CFIT; and Safety Enhancement Initiatives (SEIs) to mitigate its related Occurrences – Overview.

- ICAO regulatory provisions on CFIT.
- RASG-AFI Occurrence Data, 2013-2022.
- Safety Enhancement Initiatives (SEIs) for Mitigating risks associated with CFIT (GPWS; SOPs; CDFA; FDAP; CRM; ALAR; MSAW; PBN).
- References.
- Conclusion.
- Take-Away.



# ICAO regulatory provisions on CFIT.

What is Controlled flight into terrain (CFIT) ?

A situation where a properly functioning aircraft under the control of a fully qualified and certificated crew is flown into terrain (mountain, ground, water mass, trees, etc.) with no apparent awareness on the part of the crew.

Accident Data indicates that controlled flight into terrain (CFIT) accounts for just over 20% of all fatal accidents, a disproportionately high percentage given the low proportion of all accidents attributed to this category. While ICAO and other organizations (FSF, CAST, JSAT, JSSI, etc.) have undertaken a number of initiatives over the past 20 years which have met with considerable success, the data would suggest that additional efforts should be considered.



## ICAO regulatory provisions on CFIT (Cont'd.).

- ICAO Assembly Resolution A31-9 urges States to implement the ICAO program for the prevention of CFIT. ICAO introduced a number of amendments to SARPs and related guidance material to reduce the risk of CFIT accidents.
- Over the years, ICAO and aviation partners have taken initiatives to reduce the risk of CFIT accidents such as the production of an Approach and Landing Accident Reduction (ALAR) Toolkit; and the conduct of several workshops to encourage States, air operators, and air traffic management to implement many of the safety interventions that are contained in the Toolkit.



## **ICAO regulatory provisions on CFIT (Cont'd.).**

Each time you approach a runway, the risks associated with approach and landing accidents are present. It is this phase of flight operations where the greatest number of accidents occur. The risks include the non-stabilised approach, landing short, landing off the side of the end of the runway and controlled flight into terrain.

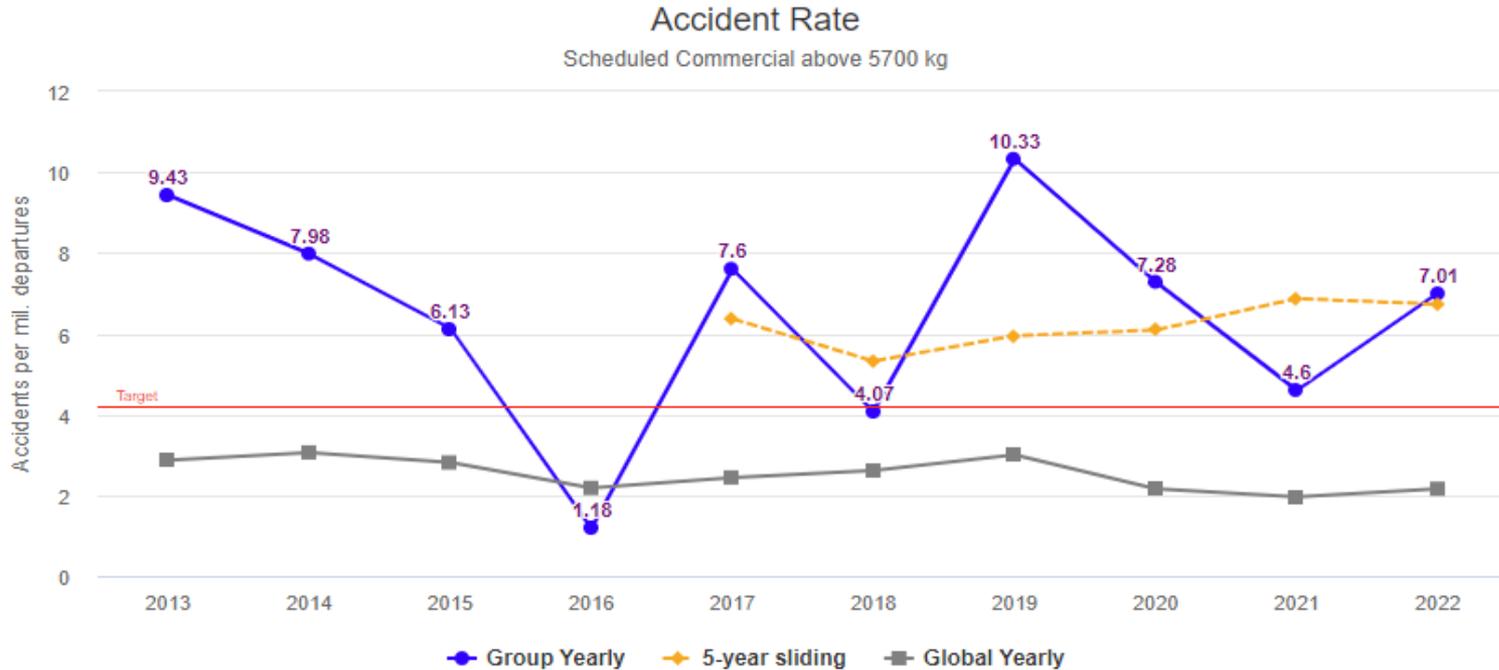
During the 1990s extensive industry attention was focused on CFIT because it was the single biggest risk to aircraft, crew and passengers.



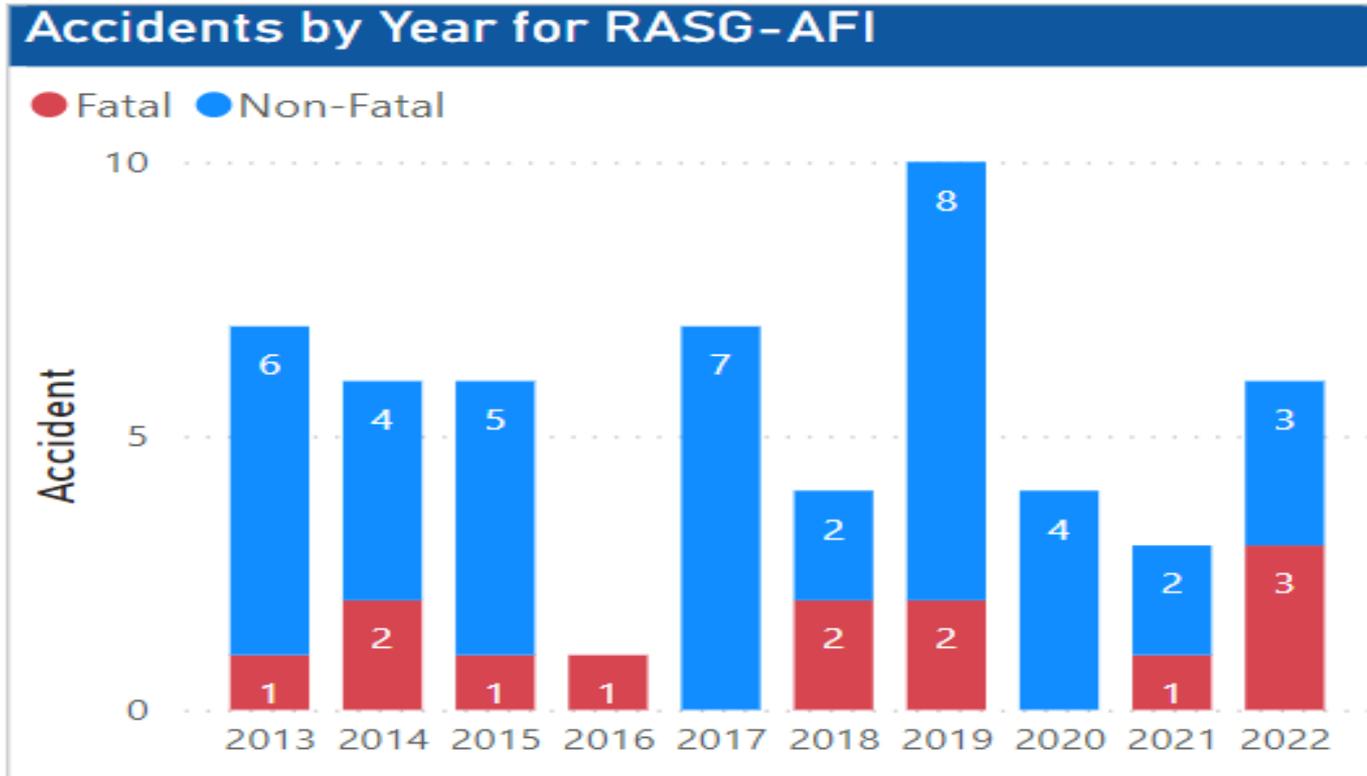
# RASG-AFI Occurrence Data, 2013-2022

- RASG-AFI Accident Rate;
- RASG-AFI Accidents by Year;
- RASG-AFI Fatalities by Year;
- RASG-AFI Accidents by Regional Office;
- RASG-AFI Accidents by Occurrence Category;
- RASG-AFI Accidents by Flight Phase;
- RASG-AFI List of Occurrences.

# RASG-AFI Accident Rate

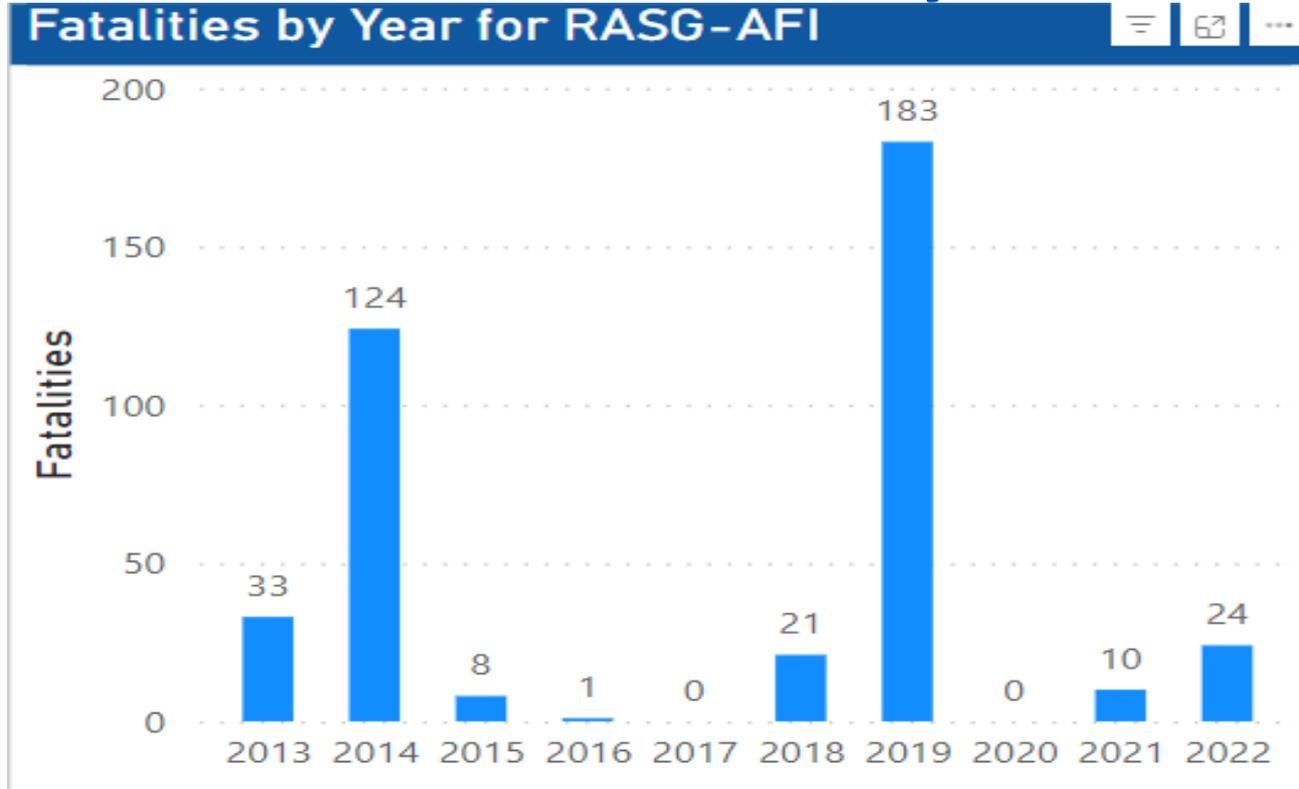


# RASG-AFI Accidents by Year



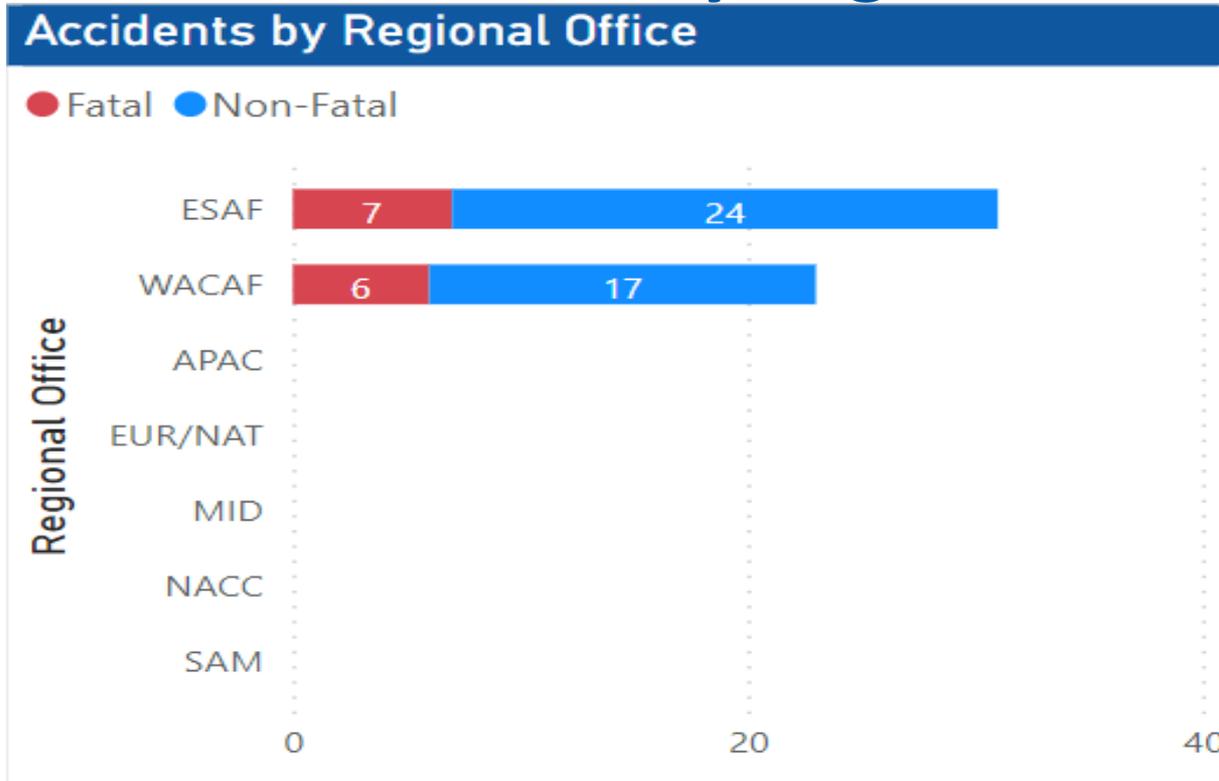


# RASG-AFI Fatalities by Year



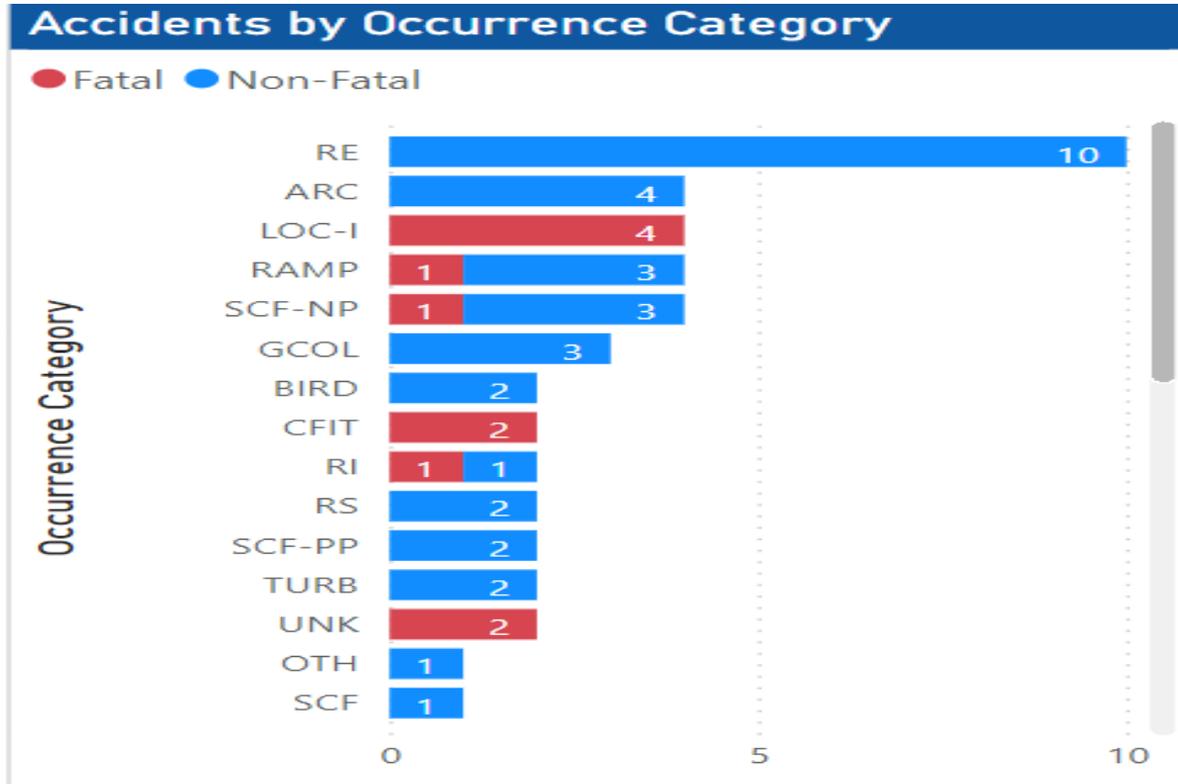


# RASG-AFI Accidents by Regional Office



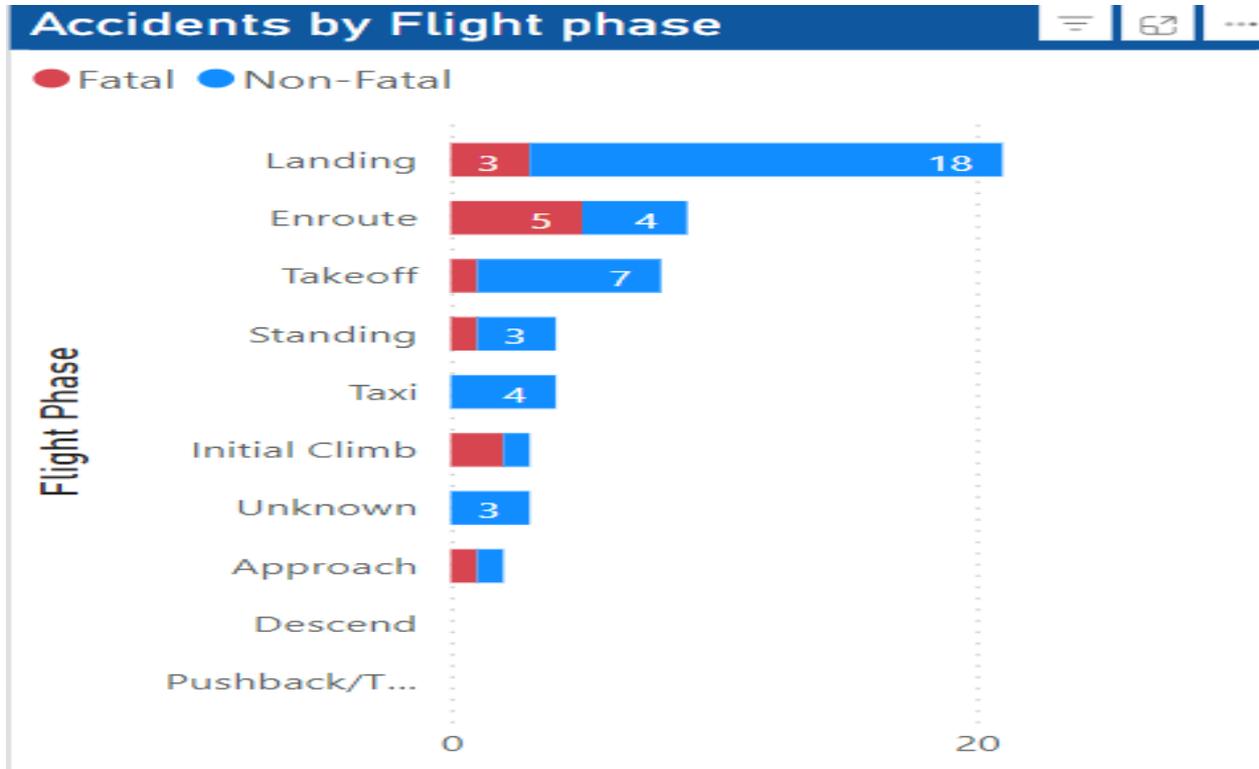


# RASG-AFI Accidents by Occurrence Category





# RASG-AFI Accidents by Flight Phase





# RASG-AFI List of Occurrences

Local Date	State of Occurrence	Manufacturer	Model	Aircraft registration	Operator	Flight phase	Occurrence Category	Aircraft damage	Injury level	Fatalities	Region
▲											
30-Apr-2017	Angola	BOEING	737-700	D2-TBF	TAAG Angola Airlines	Landing	SCF-NP	Substantial	None	0	Africa
▲											
31-Aug-2015	Botswana	BOMBARDIER	CL600 2B19	ZS-CME	CemAir	Landing	SCF-NP	Substantial	Serious	0	Africa
03-Nov-2022	Congo	LET	L410	9S-GPK	Goma Express	Enroute	LOC-I	Destroyed	Fatal	3	WACAF



## RASG-AFI List of Occurrences (Cont'd.)

28-Dec-2014	Democratic Republic of the Congo	ANTONOV	AN26	4L-AFS	AG Air	Enroute	CFIT	Destroyed	Fatal	6	Africa
01-Nov-2015	Democratic Republic of the Congo	GRUMMAN	G159	9Q-CND	Malu Aviation	Landing	SCF-NP	Substantial	Fatal	8	Africa
10-Sep-2017	Democratic Republic of the Congo	ANTONOV	AN26	9S-AFL	Serve Air Cargo	Takeoff	RE	Substantial	None	0	Africa
24-Nov-2019	Democratic Republic of the Congo	DORNIER	228	9S-GNH	BusyBee	Takeoff	LOC-I	Destroyed	Fatal	26	Africa
27-Nov-2019	Democratic Republic of the Congo	AIRBUS	A350-900	ET-AWO / TK-JOV	Ethiopian Airlines / Turkish Airlines	Taxi	GCOL	Substantial	None	0	Africa
28-Dec-2019	Democratic Republic of the Congo	LET KUNOVICE	L410	9S-GDX	Air Fast Congo	Landing	RE	Substantial	None	0	Africa
14-Aug-2021	Democratic Republic of the Congo	DE HAVILLAND	DHC8	9S-AAN	Congo Air lines	Landing	RI	Minor	None	0	Africa



## RASG-AFI List of Occurrences (Cont'd.)

22-Aug-2017	Ethiopia	AIRBUS / BOEING	A350 / 777-	ET-ATR /	Ethiopian Airlines	Taxi	GCOL	None	None	0	Africa
10-Mar-2019	Ethiopia	BOEING	737-800	ET-AVJ	Ethiopian Airlines	Initial Climb	SCF-NP; LOC-I	Destroyed	Fatal	157	Africa
24-Nov-2014	Gabon	BOEING	B 747-8R7F	LX-VCC	Cargolux	Landing	RS	Substantial	None	0	Africa
10-Jan-2015	Ghana	BOEING	737-400	ET-AQV	Ethiopian Airlines	Landing	ARC	Substantial	Serious	0	Africa
06-Oct-2015	Ghana	BAE	AVRO146RJ 300	9G-SBB	Starbow	Landing	RE	Substantial	None	0	Africa
25-Nov-2017	Ghana	ATR	ATR72-212A	9G-SBF	Starbow Airlines	Takeoff	RE	Substantial	Serious	0	Africa



## Focus on CFIT Occurrences

Although One (1) CFIT-related accident has been reported during the period 2013-2022 (Zero CFIT-related accident reported from 2015-2022) for the RASG-AFI Region, CFIT continues to be a High Risk Category of occurrence both globally (GASP, G-HRC) and regionally (AFI-RASP, R-HRC) thus, no room for complacency.



# Safety Enhancement Initiatives (SEIs) for Mitigating risks associated with CFIT

- ***Safety Enhancement Initiative CFIT 1 (SEI-1): Ground Proximity Warning Systems (GPWS) With Forward Looking Terrain Avoidance Function.***

This safety enhancement substantially reduces or eliminates CFIT accidents by improving pilot situational awareness through the installation and use of Ground Proximity Warning Systems (GPWS) with a forward looking feature (also known as TAWS or EGPWS).



## SEI-1: GPWS

- However, the accuracy of the TAWs equipment is greatly reduced in aircraft that are not equipped with Global Positioning System (GPS), especially in areas with limited Navaid coverage. In order to mitigate this situation, Advisory Circular was issued on modification of TAWS equipment to include GPS input or the development of Standard Operating procedures (SOPs) to deal with map shifts. In addition, information was provided to ensure that databases are maintained current.
- States were urged to highlight the need to ensure that the serviceability of TAWS equipment, including status of software and data base, was examined when conducting inspections of air operators.



## SEI-1: GPWS

**87%** of the accidents showed the flight crew did not execute a go-around when that could be more appropriate. Crew were not aggressive in responding to Ground Proximity Warning System (GPWS) warnings in low altitude go-around situation

**(Whoop! Whoop! Pull-up!).**

Standard Operating Procedures (SOPs) should contain appropriate information regarding these situations and those procedures should be followed.



## ***Recommendation:***

- *Modification of TAWS equipment to include GPS input or the development of SOPs to deal with map shifts. In addition, information should be provided to ensure that databases are maintained current. An Advisory Bulletin should be issued by States to highlight the need to ensure that the serviceability of TAWS equipment, including status of software and data base, is examined when conducting inspections of air operators.*



## ***Safety Enhancement Initiative CFIT 2 (SEI-2): Standard Operating Procedures.***

All air operators should have Standard Operating Procedures (SOPs) and training which should address all projected normal situations which crew and company personnel will encounter. SOPs address: use of checklists, what each person's responsibilities are, use of available equipment, and expected procedures to be used during preflight, taxi, take-off, climb, cruise, descent, approach, missed approach, landing, taxi and parking.



## SEI-2: SOPs

- **ICAO Annex 6** requires an Operations Manual which must contain SOPs for each phase of flight. Further, **ICAO *Procedures for Air Navigation Services — Aircraft Operations (PANS – OPS) Volume 1 (Doc 8168)*** contains additional guidance material on the requirements for SOPs to include checklists and crew briefings as an integral part of SOPs.



## ***Safety Enhancement Initiative CFIT 3 (SEI-3): Precision-Like Approach Standard Operating Procedures***

Analysis of accident data indicates that the accident rate is five times greater during non-precision approaches than when aircraft are conducting precision approaches. In the interest of safety, air operators should discontinue the use of step-down or “dive-and-drive” non-precision approach procedures as soon as, and wherever possible. Air operators that are yet to do so should, at the earliest possible date, develop procedures and train pilots to fly continuous descent final approaches (CDFA) when flying non-precision approach procedures. All types of aircraft can fly procedures utilizing a constant rate descent, even those with just basic navigation capabilities.



## SEI-3: CDFA

**ICAO PANS-OPS (Doc 8168), Volume I, Part I, Section 4, Chapter 1**, promotes the use of Constant Decent Final Approach through utilization of a number of techniques.

### ***Recommendation:***

- *Guidance should be issued for Operators conducting Continuous Decent Final Approach for Non-Precision Approaches, which is a technique that requires a continuous descent, flown either with VNAV guidance calculated by onboard equipment or based on manual calculation of the required rate of descent, without level-offs.*



## ***Safety Enhancement Initiative CFIT 4 (SEI-4): Flight Data Analysis.***

A Flight Data Analysis Programme (FDAP) is a predictive and non-punitive use of information derived from aircraft flight data recorders to improve aviation safety. The use of FDA as an important safety tool has grown as emerging technology expands the capabilities of gathering and analyzing such data. Daily collection and analysis of data provides valuable information to correct undesirable trends, improve safety and ultimately reduce the number of accidents.



## SEI-4: FDAP

**From 1 January 2005 Annex 6, Part 1 requires operators of aeroplanes of a maximum certificated take-off mass in excess of 27,000 kg to establish and maintain a flight data analysis programme (FDAP) as part of its accident prevention and flight safety programme. A flight data analysis programme shall be non-punitive and contain adequate safeguards to protect the source(s) of the data.**



## ***Recommendations:***

- *States should establish regulations to be utilized to implement the ICAO requirement on FDAP.*
- *Guidance material should be developed to be utilized to ensure that air operators have implemented an effective Flight Data Analysis programme.*
- *Guidance should be provided to CAA and air operator staff for the implementation of an effective Flight Data Analysis programme.*



## ***Safety Enhancement Initiative CFIT 5 (SEI-5): Crew Resource Management Training.***

Annex 6 requires air operators to provide training to flight crew on Human Factors principles. **The ICAO Human Factors Training Manual (Doc 9683), Part 2 Chapter 2**, contains information on Crew Resource Management (CRM) Training.



## ***Recommendation:***

- *Guidelines should be provided for developing, implementing, reinforcing, and assessing Crew Resource Management (CRM) training programs for flight crew members and other personnel essential to flight safety. These programs are designed to become an integral part of training and operations.*



## ***Safety Enhancement Initiative CFIT 6 (SEI-6): CFIT/ALAR Training.***

CFIT accidents could be substantially reduced if all air operators and training centers developed CFIT prevention training and procedures to be added to their approved training curriculums, stressing position awareness and escape maneuvers in the event of a terrain warning indication.



## SEI-6: ALA

Approach and Landing Accidents could also be reduced if flight crews were properly trained on topics related to stabilized approaches. This training should include: crew resource management, go around criteria, approaches with system malfunctions, non-normal conditions, and emphasis on basic airmanship, approach briefings, approach and missed approach procedures.



## SEI-6: ALA

Situational awareness is important, as crew can recognize many of the risk factors before an event threatening safety – crew action can be taken to avoid potential approach and landing accidents (ALA).

ALA causal factors include:

- Not being stabilized on approach;
- Not following established procedures;
- Lack of vertical position awareness; and most critically,
- Failure to go around.



## SEI-6: ALA

The following parameters constitute a stabilized approach and should be met at 1000ft above touchdown in IMC condition:

- Aircraft is on the correct flight path;
- Speed not more than  $VREF + 20KIAS$ , and not less than  $VREF$ ;
- Sink rate not more than 1000 feet per minute;
- Aircraft in proper approach and landing configuration;
- Power setting is no lower than minimum specified for aircraft type;
- All briefings and checklists have been performed.

All these parameters must be met by 500ft including visual approach. The SOPs should include these parameters for a stabilized approach.



## SEI-6: ALA

Weather and runway conditions are two areas which can compound the risk during landing. For example, increased risk of short runway, wet and icy runway, wind and obscuration of runway. Make preparations and decisions early!

Vertical situational awareness is your responsibility as a pilot. GPWS “**PULL-UP! PULL-UP!**” Warning you must be prepared to execute an immediate pull-up.



## ***Recommendation:***

- *States should develop appropriate legislation, regulations and/or standards to require air operators to ensure flight crew receive initial and recurrent Approach and Landing Accidents (ALA) and CFIT prevention training.*



## ***Safety Enhancement Initiative CFIT 7 (SEI-7): Minimum Safe Altitude Warning (MSAW).***

Recognizing that installation of radars and associated MSAW capability provides the necessary levels of terrain avoidance protection to aircraft operations, States are to consider this aspect when determining the justification for installation of new radar equipment. Justification would be strengthened for installation of radar where the CFIT risk is high.



# ***Safety Enhancement Initiative CFIT 8 (SEI-8): Performance-Based Navigation (PBN) Procedures.***

PBN is an international harmonization of navigation requirements and specifications based on the **accuracy/ integrity** of the aircraft position. It is based on two main sets of specifications:

- **RNAV = aRea NAVigation:** Capability to fly any desired flight path – especially on longrange flights – defined by waypoints such as geographic fixes (LAT/LONG) and not necessarily by ground nav aids.



## SEI-8: PBN

- **RNP = Required Navigation Performance**, which is GNSS based.

PBN approach procedures is a **key factor for safety enhancement**:

- Automation of approaches;
- Lateral navigation;
- Vertical navigation.



## SEI-8: PBN

ICAO controlled flight into terrain (CFIT) studies have shown that runway-aligned approaches (LNAV only) are **25 times safer** than circling approaches, and that once some form of vertical guidance is added to approaches the **safety margin is increased again by a factor of 8.**

The benefits of PBN include:

- Enhance Safety;



## SEI-8: PBN

- Improve Accessibility;
- Reduce Fuel Burn Increase Payload;
- Increase Capacity;
- Avoid Sensitive Areas.

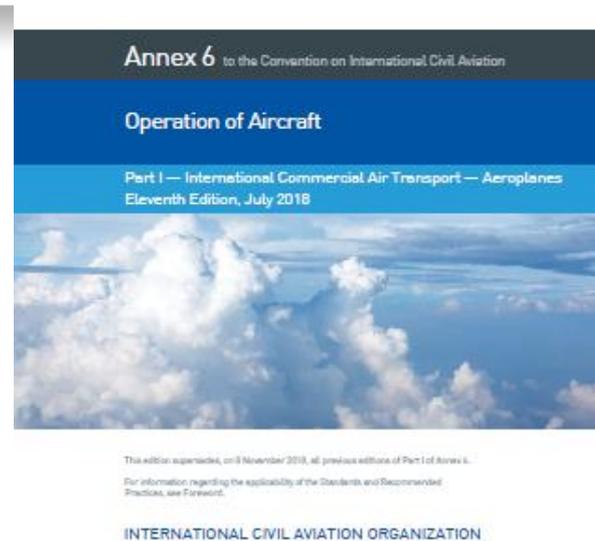


## ***Recommendation:***

*All RASG-AFI States should implement PBN procedures for all instrument runways by end of 2025.*

# ICAO References

- STD A6, Part I, 3.3 & Att. H:  
Flight Safety Documents System;
- STD A6, Part I, 3.3, 4.2.2 & App. 2, 2.1.30:  
Policy for the use of the ground proximity  
warning system (GPWS) ;
- STD A6, Part I, 3.3, 4.2.2 & App. 2, 2.1.34: Safety Management System  
(SMS);
- STD A6, Part I, 3.2.3: FDAP;





# ICAO Refs.

- PANS-OPS Doc 8168, VOL I: SOPs





## CONCLUSIONS:

- Approach and Landing Safety
- Pull up when warned;
- Use SOPs;
- Use the approach briefing plan;
- It's okay to go-around.



# Conclusions (Cont'd.)

**Good practices to avoid CFIT accidents are:**

- A. Manage Distractions**
- B. Seek proficiency training**
- C. Give yourself some room**
- D. Use Flight Risk Assessment Tools**
- E. Fly at least 500 AGL to avoid wires**
- F. All of the above**





## Take Away!

- **Safety Enhancement Initiative (SEI):** Mitigate contributing factors to CFIT accidents and incidents.
1. Implement the following CFIT global safety enhancements:
    - a) Ensure aircraft are equipped with TAWS in accordance with Annex 6;
    - b) Promote the wider use of TAWS beyond the requirements of Annex 6;
    - c) Issue Safety Advisory to increase adherence to TAWS warning procedures;



## Take Away!

- d) Promote greater awareness of approach risks;
- e) Consider the implementation of Continuous Descent Final Approaches (CDFA);
- f) Consider the implementation of Minimum Safe Altitude Warning (MSAW) systems;
- g) Ensure the timeliness of updates and accuracy of Electronic Terrain and Obstacle Data (eTOD);
- h) Promote the use of GPS-derived position data to feed TAWS;
- i) Implement PBN procedures for all instrument runways by 2025.



## Take Away!

2. Validate the effectiveness of the global safety enhancements through the analysis of MORs and VORs and accident/incident investigations (apply safety management methodologies).
3. Identify additional contributing factors for example:
  - a) Flight in adverse environmental conditions
  - b) Approach Design and documentation
  - c) Phraseology used (standard vs non-standard)
  - d) Pilot fatigue and disorientation.



## Take Away!

4. Develop and Implement further safety enhancements to mitigate the risk of the identified contributing factors, if any, for CFIT.
5. Conduct continuous evaluation of the performance of the safety enhancements.

