ADVISORY CIRCULAR

CAA-AC-OPS050

November 2022

AIR OPERATOR FLIGHT DATA ANALYSIS PROGRAMME

1.0 Purpose

1.0.1 This Advisory Circular provides to demonstrate compliance with, and information related to, requirements regarding the implementation of a Flight Data Analysis Programme (FDAP). This AC is applicable for the Air Operator Certificate (AOC) holder conducting operations under Regulation 6 of the Civil Aviation (Operation of Aircraft - Commercial Air Transport Aeroplanes) Regulations, 2022.

1.0.2 This Advisory Circular (AC) is an Initial Issue Dated November 2022

2.0 References

I The Civil Aviation (Operation of Aircraft - Commercial Air Transport Aeroplanes) Regulations, 2022.

II International Civil Aviation Organization (ICAO) Doc 9859 Safety Management Manual

III International Civil Aviation Organization (ICAO) Doc 10000 Manual on Flight Data Analysis Programmes (FDAP)

IV EASA AMC/GM to Annex III (Part-ORO)

V UK Civil Aviation Authority CAP 739 (Flight Data Monitoring), second edition dated June 2013.

3.0 Background

3.0.1 Flight Data Analysis Program (FDAP) Advisory Circular (AC) is issued by the Uganda Civil Aviation Authority (UCAA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. The AC contains information regarding standards, practices and procedures acceptable to UCAA. The AC may be used to demonstrate compliance with a statutory requirement.

3.0.2 As required by UCARs, the AOC holder of an aeroplane of a certificated take-off mass in excess of 27,000 kg shall establish and maintain a FDAP as part of its safety management system (SMS). The FDAP shall be non-punitive and contain adequate safeguards to protect the source(s) of the data.

Note: *An operator may contract the operation of a flight data analysis programme to another party while retaining overall responsibility for the maintenance of such a programme.*

3.0.3 As required by UCARs, the AOC holder of helicopter operated offshore operations. When conducting CAT operations with a helicopter equipped with a flight data recorder, the operator shall establish and maintain FDM system, as part of its integrated management system, by 1 January 2019. The FDM system shall be non-punitive and contain adequate safeguards to protect the source(s) of the data.

3.0.4 Flight Data Analysis (FDA) will enable the AOC holder to identify potential hazards to flight operations. The AOC holder may, based on analysis of flight data, amend Standard Operating Procedures (SOPs) and policy to manage its risks.

3.0.5 This AC guides the AOC holder on the set up of a FDAP that is integrated within the safety assurance component, with emphasis on data protection, de-identification and cultivation of a positive safety culture.

3.0.6 The flight data analysis programme shall be non-punitive and contain adequate safeguards to protect the source(s) of the data in accordance with Appendix 3 to Annex 19.

4.0 General

FDAPs should be used to identify systemic causes for deviation from standard operations. They can detect adverse trends in any part of the flight regime and when integrated within a SMS, it will allow an AOC holder to:

a) identify operational safety trends and areas of operational risk and quantify safety margins.

b) identify and quantify operational risks by highlighting occurrences of non-standard, unusual or unsafe circumstances.

c) use the FDAP information on the frequency of such occurrences, combined with an estimation of the level of severity, to assess the safety risks and to determine which may become unacceptable if the discovered trend continues.

d) put in place risk mitigating measures to address unacceptable risk that has been identified; and

e) monitor effectiveness of a particular risk mitigating measure.

4.1 FDAP Description

4.1.1 An FDAP may be described as a non-punitive programme for routine collection and analysis of flight data to develop objective and predictive information for advancing safety, e.g. through improvements in flight crew performance, training effectiveness, operational procedures, maintenance and engineering, and air traffic control (ATC) procedures.

4.1.2 FDA involves:

a) capturing and analysing flight data to determine if the flight deviated from a safe operating envelope.

b) identifying trends.

c) promoting action to correct potential problems.

4.1.3 Deviations of more than certain predetermined values, called “exceedances”, are flagged and evaluated. The FDA team will propose and evaluate corrective actions, as well as produce exceedances aggregation over time to determine and monitor trends. FDA also allows for early identification of aircraft system degradation for maintenance action.

4.1.4 Engine monitoring programmes may utilize FDAP data for reliable trend analysis, as manually coded engine data are limited in terms of accuracy, timeliness and reliability. It is also possible to monitor other aspects of the airframe and systems.

4.2 FDAP Reporting

4.2.1 The Operators and pilots-in-command of Uganda registered aircraft are required to report accidents, incidents or occurrences which endangers, or unless corrected would have endangered the flight crew and passenger and aircraft under the Civil Aviation (Safety Management) Regulations, 2022.

4.2.2 The reportable safety matters (or commonly known as Mandatory Occurrence Report, “MOR”). MOR incidents detected by FDAP should therefore normally be reported by the crew in accordance with the established procedures. If the MOR incident is not already reported, the AOC holder should ensure that the MOR report is made immediately. Protocols signed between the AOC holder and crew member representatives regarding FDAP should clearly be explained.

4.3 FDAP Policy

4.3.1 The protocol referred to in paragraph 1.3.2 should include an agreed policy on FDA data deidentification before it is needed in extreme circumstances. The AOC holder should provide clear and binding assurance on the nondisclosure of individuals who may be identified through the data collected. There may be exceptions such as when the AOC holder, or a flight crew member, believes that there is a continuing unacceptable safety risk if specific action regarding a flight crew member is not taken. In such a case an identification and follow-up action procedure, previously agreed to before the particular event, can be applied. There should be an initial stage during which the data can be identified to allow confidential follow up by the crew representative or trusted individual agreed to by the AOC holder and the flight crew. Strict rules of access should be enforced during this period. In the case where a MOR is required, any data retained by the programme may not be de-identified or removed from the system prior to the investigation or confirmation.

4.3.2 It is important that FDAPs are non-punitive and contain adequate safeguards to protect the source(s) of the data according to UCAA requirement no. 32 Protection of Safety Data and Safety Information.

4.4 Summary

FDAPs offer a wide spectrum of applications for safety management. Furthermore, it also offers the benefit of improving operational efficiency and economy that compensate the needed investment. The objective is to:

a) determine operating norms;

b) identify potential and actual hazards in operating procedures, fleets, aerodromes, ATC procedures, etc.;

c) identify trends;

d) monitor the effectiveness of corrective actions taken;

e) provide data to conduct cost-benefit analyses;

f) optimize training procedures; and

g) provide actual rather than presumed performance measurement for risk management purposes.

5.0 Flight Data Analysis Programme Description

5.1 FDAP Overview

5.1.1 The quality and capability of an operator’s FDAP will be dependent on the selection, availability of flight parameters, and the quick access recorder’s (QAR’s) availability. The selected flight parameters should be relevant and appropriate to reflect the safety, quality or risk level of the process thereby providing a performance track. The FDAP is not a one-size-fit-all programme. Depending on availability of resources, technology, complexity and size of operation, the FDAP may need to be tailored to suit the needs of the organisation. Briefly, the FDAP would consist of an on-board device to record data and a means to transfer the recorded data to a processing system. Thereafter, software is needed to process the data for analysis, and if desired, to develop flight animation for stakeholders’ analyses and crew debriefing.

5.1.2 As part of an operator's SMS safety assurance processes, an FDAP will have identified indicators or parameters chosen for measuring and monitoring the operator's safety performance, including “operational events”. These events may be low consequence (deviation, non-compliance events) or high consequence safety performance indicators (accident and serious incident rates). Such data are routinely fed into or part of the safety data collection and processing system (SDCPS).

5.2 FDAP Equipment

5.2.1 FDAP generally involve systems that capture flight data, transform the data into an appropriate format for analysis, and generate reports and visualisation to assist in assessing the data. Typically, the following equipment capabilities are needed for effective FDAP programmes:

a) an on-board device to capture and record data on a wide range of in-flight parameters;

b) a means to transfer the data recorded on board the aircraft to a ground-based processing station;

c) a ground-based computer system to analyse the data, identify deviations from expected performance, generate reports to assist in interpreting the read-outs, etc.; and

d) optional software for a flight animation capability to integrate all data, presenting them as a simulation of in-flight conditions, thereby facilitating visualisation of actual events.

5.2.2 Airborne Equipment

a) The flight parameters and recording capacity required for flight data recorders (FDR) to support accident investigations may be insufficient to support an effective FDAP. Other technical solutions are available, including the following:

i. Quick access recorders (QARs). QARs are installed in the aircraft and record flight data onto a low-cost removable medium.

ii. some systems automatically download the recorded information via secure wireless systems when the aircraft is in the vicinity of the gate. There are also systems that enable the recorded data to be analysed on board while the aircraft is airborne.

b) Fleet composition, route structure and cost considerations will determine the most cost-effective method of removing the data from the aircraft.

5.2.3 Ground Replay and Analysis Equipment

a) Data are downloaded from the aircraft recording device into a ground-based processing station, where the data are held securely to protect this sensitive information.

b) FDAP generate large amounts of data requiring specialised analysis software.

c) The analysis software checks the downloaded flight data for abnormalities.

d) The analysis software may include annotated data trace displays, engineering unit listings, visualisation for the most significant incidents, access to interpretative material, links to other safety information and statistical presentations.

6.0 Processing of FDA Data

6.1.1 The operator's SMS assurance processes would also have procedures for corrective or follow-up action to be taken when targets are not achieved and/or alert levels are breached that are set for each of the performance indicators/parameters.

6.1.2 Exceedance detection, such as deviations from flight manual limits or SOPs, is one way of extracting information from flight data. A set of core events/parameters establishes the main areas of interest to an operator.

6.1.3 Exceedance detection, An AOC holder can select exceedance parameters for its FDA data detection system to suit their operation. Examples of exceedances are:

a) excessive pitch on take-off;

b) climb out speed low or high during take-off;

c) stall warning;

d) ground proximity warning system (GPWS) warning;

e) flap limit speed exceedance;

f) excessive rate of descent below 1000 feet. The value of tracking exceedance data is it provides factual information which complement crew and engineering reports. g) fast approach;

h) high/low on glide slope; and

i) heavy landing

6.1.4 Exceedance data provides factual information which complement crew and engineering reports. Examples of exceedances are:

a) Reduced flap landing;

b) hard landings;

c) emergency descent;

d) engine failure;

e) rejected take-off;

f) go-around;

g) airborne collision avoidance system (ACAS); or

h) GPWS warning and system malfunctions.

6.1.5 Routine Measurements

A selection of routine parameters can also be extracted to analyse trends or tendencies and areas safety interest, where a system defining what is normal practice. This may be accomplished by retaining various snapshots of information from each flight. The examples may be categorized as

a) Flight parameters monitored such as Take-off weight; flap setting; temperature; rotation and lift-off speeds versus scheduled speeds; maximum pitch rate and attitude during rotation; and gear retraction speeds, heights and times.

b) Comparative analyses such as pitch rates from high versus low take-off weights; unstable approaches; and touchdowns points on short versus long runways.

Note: In the examples above, the measurements could result in correcting handling techniques

6.1.6 Statistics

Series of data collected to support the analysis process: this technique should include the number of flights flown per aircraft and sector details sufficient to generate rate and trend information.

6.1.7 Incident Investigation

FDAPs provide valuable information for incident investigations and for follow-up of other technical reports. Quantifiable recorded data extracted may be useful to enhance recall by the flight crew. FDAP data also provide accurate indication of system status and performance, which may assist to determine the causal factors of the incident and effect relationships.

Examples of incidents where recorded flight data could be useful: High cockpit workload conditions as corroborated by such indicators as:

a) late descent;

b) late localizer and/or glide slope interception;

c) large heading change below a specific height;

d) late landing configuration;

e) unstabilized and rushed approaches, glide path excursions, etc.;

f) exceedances of prescribed operating limitations (such as flap limit speeds, engine overtemperatures); and

g) wake vortex encounters, low-level wind shear, turbulence encounters or other vertical accelerations.

6.1.8 Continuing Airworthiness

Both routine measurements and exceedances can be utilized to assist the continuing airworthiness function. FDAP data also could be used for technical monitoring programmes for impending failure prediction and maintenance scheduling. Examples are:

a) engine deterioration programmes look at measures of engine performance to determine operating efficiency, predict impending failures and assist in maintenance scheduling.; and

b) brake and landing gear usage.

6.1.9 Integrated Safety Analysis

All the data gathered in an FDAP should be integrated in a central safety database. By linking an FDAP database to other safety databases (such as incident reporting systems and technical fault reporting systems), a more complete understanding of events becomes possible through cross-referencing the various sources of information. Care should be taken, however, to safeguard the confidentiality of FDA data when linking the data to identified data.

Example: *A heavy landing results in a flight crew report, an FDA exceedance and an engineering report. The flight crew report provides the context, the FDA exceedance provides the quantitative description and the engineering report provides the result*

6.2 Analysis and Follow-up

6.2.1 Overviews and summaries of FDA data should be compiled on a regular basis, to identify specific exceedances and emerging undesirable trends and to disseminate the information to flight crews. Revision to operating and flight manuals and changes to ATC and aerodrome operating procedures could also be outcomes of FDA data analysis.

6.2.2 De-identified FDA data should be archived as these over times can provide a picture of emerging trends and hazards in their analyses.

6.2.3 Lessons learned from an FDAP may warrant inclusion in the company's safety promotion activities. Care is required, however, to ensure that any information acquired through FDA is deidentified before using it in any training or promotional initiative unless permission is given by all the crew members involved. Care should also be taken that, in order to avoid an exceedance, flight crews do not attempt to "fly the FDA profile" rather than follow SOPs. Such a behavior would have a negative impact on safety.

6.2.4 A proper value should be programmed for trigger and exceedance and designed to include an acceptable buffer that will disregard minor deviation, spurious events, as well as introduce an adequate operational margin to fly the aeroplane through SOPs, instead of leading the flight crew to focus on FDA parameters in order to avoid deviations.

6.2.5 As in any closed-loop process, follow-up monitoring is required to assess the effectiveness of any corrective actions taken. Flight crew feedback is essential for the identification and resolution of safety problems and could include answering the following example questions:

a) Is the implementation of corrective actions adequate and effective?

b) Are the risks mitigated, or unintentionally transferred to another part of the operations?

c) Have new problems been introduced into the operation as a result of implementing corrective actions?

6.2.6 All events are usually archived in a database. The database is used to sort, validate and display the data in easy-to-understand management reports. Over time, this archived data can provide a picture of emerging trends and hazards that would otherwise go unnoticed.

6.2.7 All successes and failures should be recorded, comparing planned programme objectives with expected results. This provides a basis for review of an FDAP and the foundation for future programme development.

7.0 Prerequisites for an Effective FDAP

7.1 Protection/ De-identification of FDA Data and Follow-up

7.1.1 The protection of safety data, tenet under SMS, applies also to FDA captured under the FDAP. This is very significant in the context of an FDAP. Data protection can be optimised by:

a) adhering to the protocols between management and the flight crews, where available;

b) strictly limiting data access to selected individuals in the FDAP team;

c) maintaining tight control to ensure that data identifying a specific flight are kept secure;

d) ensuring that operation problems are promptly addressed by management; and

e) to the extent possible, non-reversible de-identification of the flight data files after a time appropriate for their analysis.

7.1.2 For similar reasons, there should be a well-structured de-identification system to protect the confidentiality of the data under the FDAP. FDA data should be de-identified by those allocated for the role before it is used in training programmes, fleet meetings or incident reviews unless permission is given by all the crew members involved. Those responsible should clearly understand that any closure of identities for purposes other than safety management can compromise the required cooperation of the affected flight crew in clarifying and/or documenting and event.

7.1.3 As in any closed-loop process, follow-up monitoring is required to assess the effectiveness of any corrective actions taken. For example, if the FDAP picks up a proliferation of high rates-of-descent events at low levels on the approach, proposals from those responsible for corrective action should be closely monitored to establish that there is tangible evidence or reduction in the frequency of these events.

7.2 Policy in Access/ Retention/ Recovery of Data

7.2.1 Due to the large volumes of data involved, it is important that a strategy for data access and security, both online and offline is carefully developed to meet the needs of FDAP user. In many cases engineering is involved in data retrieval from the aircraft. Policy on access and security must be written down clearly to cover instances like these.

7.2.2 There should be data recovery strategy to ensure a sufficiently representative capture of flight information to maintain a current overview of operations. Data recovery should take place in a timely manner to acquire knowledge of immediate safety issues, the identification of operational issues and to facilitate and necessary operational investigation before crew memories of event can fade.

7.3 Education and Communication

The objectives and the safety recommendations evolving from the FDAP should be visible to all stakeholders if the system is to receive the desire buy-in. Newsletters, flight safety magazines, highlighting examples in training and simulator exercises, periodic reports to industry and regulatory authority are some to achieve efficient communication and dissemination of such information.

7.4 Requisite Safety Culture

Indicators of an effective safety culture typically include:

a) top management's demonstrated commitment to promoting a proactive safety culture;

b) a non-punitive operator policy that covers the FDAP;

c) FDAP management by dedicated staff under the authority of the safety manager, with a high degree of specialisation and logistical support;

d) involvement of persons with appropriate expertise when identifying and assessing the risks (for example, pilots experienced on the aircraft type being analysed);

e) monitoring fleet trends aggregated from numerous operations, not focusing only on specific events;

f) a well-structured system to protect the confidentiality of the data; and

g) an efficient communication system for disseminating hazard information (and subsequent risk assessments) internally and to other organisations to permit timely safety action.

8.0 Establishing and Implementing an FDAP

8.1 Implementation Plan

8.1.1 Typically, the following steps are required to be taken by the AOC holder to implement an FDAP:

a) management approval of programme;

b) implementation of formal agreement between management and flight crews;

c) identification of FDAP team, selection and training of dedicated and experienced staff to operate the programme.

8.2 Aims and Objectives of an FDAP

8.2.1 As with any project there is a need to define the direction and objectives of the work. A phased approach is recommended so that the foundations are in place for possible subsequent expansion into other areas. Using a building block approach will allow expansion, diversification, and evolution through experience.

Example*: with a modular system, begin by looking at basic safety-related issues only. Add engine health monitoring, etc. in the second phase. Ensure compatibility with other systems.*

8.2.2 A staged set of objectives starting from the first week's replay and moving through early production reports into regular routine analysis will contribute to a sense of achievement as milestones are met.

Examples of short-term, medium-term and long-term goals:

a) *Short-term goals:*

i. *establish data download procedures, test replay software and identify aircraft defects;*
ii. *validate and investigate exceedance data; and*
iii. *establish a user-acceptable routine report format to highlight individual exceedances and facilitate the acquisition of relevant statistics.*

b) *Medium-term goals:*

i. *produce an annual report — include key performance indicators; ii. add other modules to the analysis (e.g. continuing airworthiness); and iii. plan for the next fleet to be added to programme.*

c) Long-term goals:

i. *network FDAP information across all of the operator's safety information systems; ii. ensure FDAP provision for any proposed alternative training and qualification programme (ATQP); and iii. use utilisation and condition monitoring to reduce spares holdings.*

8.2.3 Initially, focusing on a few known areas of interest will help prove the system's effectiveness. In contrast to an undisciplined 'scatter-gun' approach, a focused approach is more likely to gain early success.

8.3 FDAP Team

8.3.1 Preferably, the responsibility of the Safety Manager should include the implementation of the FDAP and must ensure that trends analysed and mitigation measures must be transmitted to the relevant parties. The team should comprise the following entities

a) Team leader

It is essential that the team leader earns the trust and full support of both management and flight crews. He/she acts independently of others in line management to make recommendations that will be seen by all to have a high level of integrity and impartiality. The individual requires good analytical, presentation and management skills. He/she should be the safety manager or placed under the authority of the safety manager.

b) Flight operations representative/s

This is person/s is usually an experienced pilot on the aircraft type and operation. This team member's in-depth knowledge of SOPs, aircraft handling characteristics, training concepts, airports and routes will be used to place the FDA data in a credible context.

c) Technical representative/s

The person/s interprets FDA data with respect to the technical aspects of the aircraft operation and is familiar with the power plan, structures and systems departments' requirements for information and any other engineering monitoring programmes in use by the AOC holder.

d) Flight crew contact person

The person could be a pilot association officer. He is person usually assigned by the AOC holder for this responsibility. The position requires good people skills and a positive attitude towards safety education. The flight crew contact person should be the only person permitted to connect the identifying data with the event. The flight crew contact person requires the trust of both flight crew members and managers for his/her integrity and good judgement. He should be trained in using FDA data animation for debriefing purposes.

e) Engineering technical support

This person/s is usually an avionics specialist, involved in the supervision of FDR serviceability. Indeed, an FDAP can be used to monitor the quality of flight parameters sent both to FDR and to the FDA recorder, and thus ensure the continued serviceability of the FDR. This team member should be knowledgeable about FDA and the associated systems needed to run the programme.

f) Air safety coordinator

This person cross-references FDA information with other safety data sources (such as the company's mandatory or confidential incident reporting programme, crew resource management and LOSA) and with the AOC holder's SMS, creating a credible integrated context and information. This function can reduce duplication to follow-up investigations.

g) Replay operative and administrator

This person is responsible to the day-to-day running of the system, producing reports and analyses, Methodical, with some knowledge of general operating environment, this person keeps the programme moving. AOC holders may utilise the services of a specialist contractor to operate an FDAP.

8.3.2 This team should be involved in all the ensuring steps:

a) development of a FDAP business plan, including processes, software and hardware and assignment of adequate resources;

b) establishment and verification of operational and security procedures;

c) development of an FDAP procedures manual;

d) assessment of possible interfaces between an FDAP and other safety data sources of integration of an FDAP into the SMS;

e) selection of equipment (airborne, ground-based computer system, interface with other data sources and the SMS);

f) selection and training of the FDAP team members, according to their respective roles;

g) testing of data transfer, testing of the ground-based computer system (including data acquisition, definition of trigger logic expression, alerts, data analysis and visualization, data de-identification, final storage of data);

h) testing if data security, including security procedures;

i) identification of areas of interest that should be first looked at in the data;

j) checking of the proper decoding and of the quality of flight parameters used by an FDAP; and

k) start of data analysis and validation, focused on key areas in operation.

8.4 Continuous Improvement

New safety issues identified and published by other organisations, such as safety investigation reports, safety bulletins by the aircraft manufacturer of safety issues identified by aviation authorities should be assessed for inclusion in a corresponding monitoring activity of an FDAP.

The FDA processes and procedures should be amended when an FDAP matures and each time there are changed in the operations, the internal organization of the AOC holder, or the interface with other data sources and processes

9.0 FDAP Procedure Documentation

9.1 Disclosure Prevention

The FDAP procedure document, or memorandum of understanding (MOU), to prevent disclosure of crew identity should be written in a document is to be signed by all parties (airline management including the Flight Safety Manager and the Accountable Manager, flight crew member representatives nominated by the pilot association) will, as a minimum define:

9.1.2 The aim of the FDAP;

9.1.2.1 A data access and security policy that should restrict access to information to specifically authorised persons identified by their position;

9.1.2.2 The method to obtain de-identified crew feedback on those occasions that require specific flight follow-up for contextual information; where such crew contact is required the authorised persons need not necessarily be the program manager, or safety manager, but could be a third party (broker) mutually acceptable to flight crew member’s representative and management;

9.1.2.3The data retention policy and accountability including the measures taken to ensure the security of the data;

9.1.2.4 The conditions under which, on the rare occasions, advisory briefing or remedial training should take place; this should always be carried out in a constructive and non-punitive manner;

9.1.2.5 The conditions under which the confidentiality may be withdrawn (e.g. for reasons of gross negligence or significant continuing safety concern);

9.1.2.6 The participation of flight crew member representative(s) in the assessment of the data, the action and review process and the consideration of recommendations; and

9.1.2.7 The policy for the publishing the findings resulting from the FDAP.

UGANDA CIVIL AVIATION AUTHORITY
DIRECTOR
SAFETY, SECURITY AND ECONOMIC REGULATION

Uganda Civil Aviation Authority

Appendix A

Example of FDAP Events

A.1 Table 1 provides examples of FDAP events that may be further developed using operator and aeroplane specific limits. More important than the number of FDAP event definitions that are programmed in the FDA software is that those definitions cover, as much as practicable, the operational risks that have been identified by the operator.

Event Group	Description
Rejected take-off	High speed rejected take-off
Take-off pitch	Pitch rate low or high on take-off
	Pitch attitude high during take-off
Unstick speeds	Unstick speed high
	Unstick speed low
Height loss in climb-out	Initial climb height loss 20 ft above ground level (AGL) to 400 ft above aerodrome level (AAL)
	Initial climb height loss 400 ft to 1 500 ft AAL
Slow climb-out	Excessive time to 1 000 ft AAL after take-off
Climb-out speeds	Climb-out speed high below 400 ft AAL
	Climb-out speed high 400 ft AAL to 1 000 ft AAL
	Climb-out speed low 35 ft AGL to 400 ft AAL
	Climb-out speed low 400 ft AAL to 1 500 ft AAL
High rate of descent	High rate of descent below 2 000 ft AGL
Missed approach	Missed approach below 1 000 ft AAL
	Missed approach above 1 000 ft AAL
Low approach	Low on approach
Glideslope	Deviation under glideslope
	Deviation above glideslope (below 600 ft AGL)
Approach power	Low power on approach
Approach speeds	Approach speed high within 90 seconds of touchdown
	Approach speed high below 500 ft AAL

	Approach speed high below 50 ft AGL
	Approach speed low within 2 minutes of touchdown
Landing flap	Late land flap (not in position below 500 ft AAL)
	Reduced flap landing
	Flap load relief system operation
Landing pitch	Pitch attitude high on landing
	Pitch attitude low on landing
Bank angles	Excessive bank below 100 ft AGL
	Excessive bank 100 ft AGL to 500 ft AAL
	Excessive bank above 500 ft AGL
	Excessive bank near ground (below 20 ft AGL)
Normal acceleration	High normal acceleration on ground
Event Group	**Description**
	High normal acceleration in flight flaps up (+/- increment)
	High normal acceleration in flight flaps down (+/- increment)
	High normal acceleration at landing
Abnormal configuration	Take-off configuration warning
	Early configuration change after take-off (flap)
	Speed brake with flap
	Speed brake on approach below 800 ft AAL
	Speed brake not armed below 800 ft AAL
Ground proximity warning	Ground proximity warning system (GPWS) operation - hard warning
	GPWS operation — soft warning
	GPWS operation — windshear warning
	GPWS operation — false warning
Airborne collision avoidance system (ACAS II) warning	ACAS operation — Resolution Advisory
Margin to stall/buffet	Stick shake
	False stick shake
	Reduced lift margin except near ground
	Reduced lift margin at take-off

	Low buffet margin (above 20 000 ft)
Aircraft flight manual limitations	Maximum operating speed limit (VMO) exceedance
	Maximum operating speed limit (MMO) exceedance
	Flap placard speed exceedance
	Gear down speed exceedance
	Gear selection up/down speed exceedance
	Flap/slat altitude exceedance
	Maximum operating altitude exceedance

A.2 Table 2 provides examples of FDAP event definitions that may be further developed using operator- and helicopter-specific limits. This table is considered illustrative and non-exhaustive. More important than the number of FDAP event definitions that are programmed in the FDA software is that those definitions cover, as much as practicable, the operational risks that have been identified by the operator.

Event title/description	Parameters required	Comments
Ground		
Outside air temperature (OAT) high — Operating limits	OAT	To identify when the helicopter is operated at the limits of OAT.
Sloping-ground high-pitch attitude	Pitch attitude, ground switch (similar)	To identify when the helicopter is operated at the slope limits.
Sloping-ground high-roll attitude	Roll attitude, ground switch (similar)	To identify when the helicopter is operated at the slope limits.
Rotor brake on at an excessive number of rotations (main rotor speed) (NR)	Rotor brake discreet, NR	To identify when the rotor brake is applied at too high NR.
Ground taxiing speed — max	Ground speed (GS), ground switch (similar)	To identify when the helicopter is ground taxied at high speed (wheeled helicopters only).
Air taxiing speed — max	GS, ground switch (similar), radio altitude (Rad Alt)	To identify when the helicopter is air taxied at high speed.

Excessive power during ground taxiing	Total torque (Tq), ground switch (similar), GS	To identify when excessive power is used during ground taxiing.
Pedal — max left-hand (LH) and right-hand (RH) taxiing	Pedal position, ground switch (similar), GS or NR	To identify when the helicopter flight controls (pedals) are used to excess on the ground. GS or NR to exclude control test prior to rotor start.
Excessive yaw rate on ground during taxiing	Yaw rate, ground switch (similar), or Rad Alt	To identify when the helicopter yaws at a high rate when on the ground.
Yaw rate in hover or on ground	Yaw rate, GS, ground switch (similar)	To identify when the helicopter yaws at a high rate when in a hover.
High lateral acceleration (rapid cornering)	Lateral acceleration, ground switch (similar)	To identify high levels of lateral acceleration, when ground taxiing, that indicate high cornering speed.
Event title/description	**Parameters required**	**Comments**
High longitudinal acceleration (rapid braking)	Longitudinal acceleration, ground switch (similar)	To identify high levels of longitudinal acceleration, when ground taxiing, that indicate excessive braking.
Cyclic-movement limits during taxiing (pitch or roll)	Cyclic stick position, ground switch (similar), Rad Alt, NR or GS	To identify excessive movement of the rotor disc when running on ground. GS or NR to exclude control test prior to rotor start.
Excessive longitudinal and lateral cyclic rate of movement on ground	Longitudinal cyclic pitch rate, lateral cyclic pitch rate, NR	To detect an excessive rate of movement of cyclic control when on the ground with rotors running.
Lateral cyclic movement — closest to LH and RH rollover	Lateral cyclic position, pedal position, roll attitude, elapsed time, ground switch (similar)	To detect the risk of a helicopter rollover due to an incorrect combination of tail rotor pedal position and lateral cyclic control position when on ground.

Excessive cyclic control with insufficient collective pitch on ground	Collective pitch, longitudinal cyclic pitch, lateral cyclic pitch	To detect an incorrect taxiing technique likely to cause rotor head damage.
Inadvertent lift-off	Ground switch (similar), autopilot discreet	To detect inadvertent lifting into hover.
Flight — Take-off and landing		
Day or night landing or takeoff	Latitude and Longitude (Lat & Long), local time or UTC	To provide day/night relevance to detected events.
Specific location of landing or take-off	Lat & Long, ground switch (similar), Rad Alt, total Tq	To give contextual information concerning departures and destinations.
Gear extension and retraction — airspeed limit	Indicated airspeed (IAS), gear position	To identify when undercarriage airspeed limitations are breached.
Gear extension & retraction — height limit	Gear position, Rad Alt	To identify when undercarriage altitude limitations are breached.
Heavy landing	Normal/vertical acceleration, ground switch (similar)	To identify when hard/heavy landings take place.
Cabin heater on (take-off and landing)	Cabin heater discreet, ground switch (similar)	To identify use of engine bleed air during periods of high power demand.
High GS prior to touchdown (TD)	GS, Rad Alt, ground switch (similar), elapsed time, latitude, longitude	To assist in the identification of ‘quick stop’ approaches.

Event title/description	Parameters required	Comments
Flight — Speed		
High airspeed — with power	IAS, Tq 1, Tq 2, pressure altitude (Palt), OAT	To identify excessive airspeed in flight.
High airspeed — low altitude	IAS, Rad Alt	To identify excessive airspeed in low-level flight.
Low airspeed at altitude	IAS, Rad Alt	To identify a ‘hover out of ground’ effect.
Airspeed on departure (< 300 ft)	IAS, ground switch (similar), Rad Alt	To identify shallow departure.
High airspeed — power off	IAS, Tq 1, Tq 2 or one engine inoperative	To identify limitation exceedance of power-off airspeed.

Downwind flight within 60 sec of take-off	IAS, GS, elapsed time	To detect early downwind turn after take-off.
Downwind flight within 60 sec of landing	IAS, GS, elapsed time	To detect late turn to final shortly before landing.
Flight — Height		
Altitude — max	Palt	To detect flight outside of the published flight envelope.
Climb rate — max	Vertical speed (V/S), or Palt, or Rad Alt, Elapsed time	Identification of excessive rates of climb (RoC) can be determined from an indication/rate of change of Palt or Rad Alt.
High rate of descent	V/S	To identify excessive rates of descent (RoD).
High rate of descent (speed or height limit)	V/S, IAS or Rad Alt or elevation	To identify RoD at low level or low speed.
Settling with power (vortex ring)	V/S, IAS, GS, Tq	To detect high-power settling with low speed and with excessive rate of descent.
Minimum altitude in autorotation	NR, total Tq, Rad Alt	To detect late recovery from autorotation.
Low cruising (inertial systems)	GS, V/S, elevation, Lat & Long	To detect an extended lowlevel flight. Ground speed is less accurate with more false alarms. Lat & Long used for geographical boundaries.
Low cruising (integrated systems)	Rad Alt, elapsed time, Lat & Long, ground switch (similar)	To detect an extended lowlevel flight.

Event title/description	Parameters required	Comments
Flight — Attitude and controls		
Excessive pitch (height related — turnover (T/O), cruising or landing)	Pitch attitude, Rad Alt elevation, Lat & Long	To identify inappropriate use of excessive pitch attitude during flight. Height limits may be used (i.e. on take-off and landing or < 500 ft) — Lat & Long required for specific location-related limits. Elevation less accurate than Rad Alt. Elevation can be used to identify the landing phase in a specific location.
Excessive pitch (speed related — T/O, cruising or landing)	Pitch attitude, IAS, GS, Lat & Long	To identify inappropriate use of excessive pitch attitude during flight. Speed limits may be used (i.e. on take-off and landing or in cruising) — Lat & Long required for specific location-related limits. GS less accurate than IAS.
Excessive pitch rate	Pitch rate, Rad Alt, IAS, ground switch (similar), Lat & Long	To identify inappropriate use of excessive rate of pitch change during flight. Height limits may be used (i.e. on take-off and landing). IAS only for IAS limit, ground switch (similar) and Lat & Long required for specific-location related limits.
Excessive roll/bank attitude (speed or height related)	Roll attitude, Rad Alt, IAS/GS	To identify excessive use of roll attitude. Rad Alt may be used for height limits, IAS/GS may be used for speed limits.

Excessive roll rate	Roll rate, Rad Alt, Lat & Long, Ground switch (similar)	Rad Alt may be used for height limits, Lat & Long and ground switch (similar) required for specific-location-related and air/ground limits.
Excessive yaw rate	Yaw rate	To detect excessive yaw rates in flight.
Excessive lateral cyclic control	Lateral cyclic position, ground switch (similar	To detect movement of the lateral cyclic control to extreme left or right positions. Ground switch (similar) required for pre or post T/O.

Event title/description	Parameters required	Comments
Excessive longitudinal cyclic control	Longitudinal cyclic position, ground switch (similar)	To detect movement of the longitudinal cyclic control to extreme forward or aft positions. Ground switch (similar) required for pre or post T/O.
Excessive collective pitch control	Collective position, ground switch (similar)	To detect exceedances of the aircraft flight manual (AFM) collective pitch limit. Ground switch (similar) required for pre or post T/O.
Excessive tail rotor control	Pedal position, ground switch (similar)	To detect movement of the tail rotor pedals to extreme left and right positions. Ground switch (similar) required for pre or post T/O.
Maneuver G loading or turbulence	Lat & Long, normal accelerations, ground switch (similar) or Rad Alt	To identify excessive G loading of the rotor disc, both positive and negative. Ground switch (similar) required to determine air/ground. Rad Alt required if height limit required.

Pilot workload/turbulence	Collective and/or cyclic and/or tail rotor pedal position and change rate (Lat & Long)	To detect high workload and/or turbulence encountered during take-off and landing phases. Lat & Long required for specific landing sites. A specific and complicated algorithm for this event is required.
Cross controlling	Roll rate, yaw rate, pitch rate, GS, accelerations	To detect an ‘out of balance’ flight. Airspeed could be used instead of GS.
Quick stop	GS (min and max), V/S, pitch	To identify inappropriate flight characteristics. Airspeed could be used instead of GS.
Flight — General		
OEI — Air	OEI discreet, ground switch (similar)	To detect OEI conditions in flight.
Single engine flight	No 1 engine Tq, No 2 engine Tq	To detect single-engine flight.
Pilot event	No 1 engine Tq, No 2 engine Tq	To identify engine-related issues.

Event title/description	Parameters required	Comments
Traffic collision avoidance system (TCAS) traffic advisory (TA)	TCAS TA discreet	To identify TCAS alerts.
Training computer active	Training computer mode active or discreet	To identify when helicopter have been on training flights.
High/low rotor speed — power on	NR, Tq (ground switch (similar), IAS, GS)	To identify mishandling of NR. Ground switch (similar), IAS or ground speed required to determine whether helicopter is airborne.
High/low rotor speed — power off	NR, Tq (ground switch (similar), IAS, GS)	To identify mishandling of NR. Ground switch (similar), IAS or ground speed to

		determine whether helicopter is airborne.
Fuel content low	Fuel contents	To identify low-fuel alerts.
Helicopter terrain awareness and warning system (HTAWS) alert	HTAWS alerts discreet	To identify when HTAWS alerts have been activated.
Automatic voice alert device (AVAD) alert	AVAD discreet	To identify when AVAD alerts have been activated.
Bleed air system use during take-off (e.g. heating)	Bleed air system discreet, ground switch (similar), IAS	To identify use of engine bleed air during periods of high power demand.
Rotors' running duration	NR, elapsed time	To identify rotors' running time for billing purposes.
Flight — Approach		
Stable approach heading change	Magnetic heading, Rad Alt, ground switch (similar), gear position, elapsed time	To identify unstable approaches.
Stable approach pitch attitude	Pitch attitude, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Stable approach rod GS	Altitude rate, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Stable approach track change	Track, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Stable approach angle of bank	Roll attitude, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Stable approach — rod at specified height	Altitude rate, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Stable approach — IAS at specified height	IAS, Rad Alt, ground switch (similar), gear position	To identify unstable approaches.
Glideslope deviation above or below	Glideslope deviation	To identify inaccurately flown instrument landing system (ILS) approaches.
Localiser deviation left and right	Localiser deviation	To identify inaccurately flown ILS approaches.

Event title/description	Parameters required	Comments
Low turn to final	Elevation, GS, V/S, heading change	Airspeed could be used instead of GS.
Premature turn to final	Elevation, GS, V/S, heading change	Airspeed could be used instead of GS.
Stable approach — climb	IAS (min & max), V/S (min & max), elevation	To identify unstable approaches.
Stable approach — descent	IAS (min & max), V/S, elevation	To identify unstable approaches.
Stable approach — bank	IAS (min & max), V/S, elevation, roll	To identify unstable approaches.
Stable approach — late turn	Heading change, elevation, GS	To identify unstable approaches.
Go-around	Gear select (Rad Alt)	To identify missed approaches. Rad Alt for height limit.
Rate of descent on approach	Altitude rate, Rad Alt, Lat & Long, ground switch (similar)	To identify high rates of descent when at low level on approach. Rad Alt if below specified height, Lat & Long for specified location required.
Flight — Autopilot		
Condition of autopilot in flight	Autopilot discreet	To detect flight without autopilot engaged; per channel for multichannel autopilots.
Autopilot engaged within 10 sec after take-off	Autopilot engaged discreet, elapsed time, ground switch (similar), total Tq, Rad Alt	To identify inappropriate use of autopilot when on ground. Elapsed time required to allow for permissible short periods.
Excessive pitch attitude with autopilot engaged on ground (offshore)	Pitch attitude, autopilot discreet, ground switch (similar), Lat & Long	To identify potential for low NR when helicopter pitches on floating helideck.
Airspeed hold engaged — airspeed (departure or nondeparture)	Autopilot modes discreet, IAS, (ground switch (similar), total Tq, Rad Alt)	To detect early engagement of autopilot higher modes. Ground switch (similar), total Tq and Rad Alt to

		determine if the flight profile is ‘departure’.
Airspeed hold engaged — altitude (departure or nondeparture)	Autopilot modes discreet, Rad Alt, (IAS, ground switch (similar), total Tq)	To detect early engagement of autopilot higher modes. IAS, ground switch (similar), total Tq to determine if the flight profile is ‘departure’.
Alt mode engaged — altitude (departure or non-departure)	Autopilot modes discreet, Rad Alt, (ground switch (similar), total Tq, IAS)	To detect early engagement of autopilot higher modes. Ground switch (similar), total Tq and Rad Alt to determine if the flight profile is ‘departure’.

Event title/description	Parameters required	Comments
Alt mode engaged — airspeed (departure or non-departure)	Autopilot modes discreet, IAS, (ground switch (similar), total Tq, Rad Alt)	To detect early engagement of autopilot higher modes. IAS, ground switch (similar), total Tq to determine if the flight profile is ‘departure’.
Heading mode engaged — speed	Autopilot modes discreet, IAS	To detect engagement of autopilot higher modes below minimum speed limitations. Ground switch (similar), total Tq and Rad Alt to determine if the flight profile is ‘departure’.
V/S mode active — below specified speed	Autopilot modes discreet, IAS	To detect engagement of autopilot higher modes below minimum speed limitations.
VS mode engaged — altitude (departure or non-departure)	Autopilot modes discreet, IAS, (WOW, total Tq, Rad Alt)	To detect early engagement of autopilot higher modes. Ground switch (similar), total Tq and Rad Alt to determine if the flight profile is ‘departure’.

Flight director (FD) engaged — speed	FD discreet, IAS	To detect engagement of autopilot higher modes below minimum speed limitations.
FD-coupled approach or take off — airspeed	FD discreet, IAS, ground switch (similar)	To detect engagement of autopilot higher modes below minimum speed limitations.
Go-around mode engaged — airspeed	Autopilot modes discreet, IAS, ground switch (similar), total Tq, Rad Alt	To detect engagement of autopilot higher modes below minimum speed limitations.
Flight without autopilot channels engaged	Autopilot channels	To detect flight without autopilot engaged, per channel for multichannel autopilots.

Appendix B

General FDAP Management Flowchart