Version 1.0

HO-HFDM-RP-v1.0

# Helicopter Flight Data Monitoring (HFDM)

## Recommended Practice for Oil and Gas Passenger Transport Operations

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*Safety Through Collaboration*

## Safety Through Collaboration

Collaboration empowers safety and is at the very heart of HeliOffshore. This HFDM Recommended Practice is a great example of how our industry – from designers and maintainers, to pilots and passengers – works together and learns from each other to ensure no lives are lost in offshore flight.

I would like to thank the HeliOffshore HFDM Working Group, industry stakeholders and every HeliOffshore member who came together to deliver this guidance. Thank you for your commitment and contribution. Together, we will implement and sustain ever-higher levels of performance so those we are responsible for travel home safely every day.

*Tim Rolfe*
*CEO, HeliOffshore*

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# Section 1 Introduction

# Section 1
# Introduction

## 1.1 What is the aim of this document?

This is a compilation of recognized best practices collected from aircraft operators, industry groups, regulatory agencies, educational organizations and individual experts in this field. It is not intended to replace official or regulatory guidance material, but to provide useful information to those looking to implement or improve their Helicopter Flight Data Monitoring (HFDM) programmes.

The document is not specifically aimed at those who are considering setting up an HFDM programme; there are various considerations and enrolment procedures that an operator would want to undertake that are not described here. Other documents provide specific guidance on establishing an (H)FDM programme including AC-120 from the FAA[1], CAP 739 from the UK CAA[2], the *HFDM toolkit* from the IHST/IHSF[3] and the ICAO *Manual on Flight Data Analysis Programmes*[4]. Instead, this document aims to describe the features of a mature, functioning HFDM programme and as such can provide an 'aim point' for those establishing a new programme.

## 1.2 Who is this document aimed at?

The practices described in this document are aimed at helicopters performing Commercial Air Transport (CAT) of passengers in support of Oil and Gas. In general, for this application, the guidance will relate most closely to larger helicopters supplied with an HFDM capability. However, the principles described in this document can be applied to any helicopter capable of capturing data.

# Section 2 Background

# Section 2
# Background

The International Helicopter Safety Foundation (IHSF)[3] defines Helicopter Flight Data Monitoring (HFDM) as *"a systematic method of accessing, analyzing, and acting upon information obtained from flight data to identify and address operational risks before they can lead to incidents and accidents."* This concept has also variously been described as: Helicopter Flight Operational Quality Assurance (HFOQA); Helicopter Operations Monitoring Programme (HOMP); Line Activity Monitoring Programme (LAMP); Flight Data Analysis Programme (FDAP) and more. The term HFDM will be used in this document to represent all of these different descriptions. While much of an HFDM programme will be similar to the equivalent system in fixed-wing, at present there are sufficient differences to warrant the different name.

## 2.1 Brief history of HFDM in Offshore Operations

In late 1998, following the successful completion of an initial feasibility study, the UK CAA instigated trials of an FDM programme for North Sea helicopters, known as the *Helicopter Operations Monitoring Programme* (HOMP)[5,6]. The HOMP trial represented one of the first applications of FDM to helicopters, although the groundwork was arguably laid by the *Helicopter Operational Monitoring Project* report in 1997[7] and the *Super Puma Operational Usage Analysis* report in 1990[8].

Since then, the use of HFDM has grown considerably and today, most helicopter operators supporting the major oil and gas producers have active HFDM programmes. The International Association of Oil and Gas Producers (IOGP) *Offshore Helicopter Recommended Practices*[9] states an expectation that *"a Helicopter Flight Data Monitoring (HFDM) programme is in place"*. Similarly, the Flight Safety Foundation *Standard for Offshore Helicopter Operations* (SOHO)[10] requires HFDM for contracts exceeding 6 months.

In the past, HFDM has been most commonly employed by large operators on heavy aircraft. However, progress in technology and a recognition of the value of HFDM has led to the wider introduction of programmes, even for small fleets and light aircraft within smaller operators.

## 2.2 Objectives and Benefits of an HFDM Programme

The benefits of FDM within fixed wing operations are well-documented. HFDM, despite having different complexities, can offer many similar benefits to operators, including:

- proactive risk monitoring (see *Section 2.3*) including organizational or procedural drift, systemic issues and operating environment;
- enhancing training effectiveness;
- compliance monitoring;
- monitoring the effectiveness of risk mitigations that have been introduced;
- improved investigation of events; and
- enhanced crew feedback.

Running an effective HFDM system may also offer financial benefits such as reduced insurance premiums, enhanced operational efficiencies, a reduction in incidents and maintenance improvements stemming from better data availability.

## 2.3 HFDM as Part of an SMS

The ICAO *Safety Management Manual*[11] notes that *"Safety Management seeks to proactively mitigate safety risks before they result in aviation accidents and incidents."*. An active safety management system (SMS) has been a requirement for most aircraft operators for a number of years. A full discussion of safety management is beyond the scope of this document and significant resources are available to help operators with the implementation of their SMS; the ICAO *Safety Management Manual*[11] is a good starting point.

The ICAO SMS framework[11] is made up of four components:

- Safety policy and objectives;
- Safety risk management;
- Safety assurance; and
- Safety promotion.

HFDM has a significant role to play in the operator's SMS. Hazard identification is the first step in the safety risk management (SRM) process and ICAO[11] lists HFDM as a *"Source for Hazard Identification"* alongside other sources such as: line operations safety audits (LOSA); voluntary and mandatory reporting systems; audits; feedback from training; and service provider safety investigations. Compared with the other sources, HFDM has the benefit of automated collection of objective data that can be quickly analysed.

ICAO[11] lists HFDM as a *"Proactive"* hazard identification methodology. Rather than focussing on past outcomes or events and the investigation of safety occurrences (*"Reactive"*) the focus of an HFDM system should be on lower consequence events to assess whether a hazard could lead to an accident or incident[11].

That is not to say that HFDM cannot support reactive hazard identification, but the primary role of an HFDM programme should not be to spot individual exceedances or deviations. Instead, it should focus on the larger datasets and trends, with ‘compliance monitoring’ being a much smaller part. Furthermore, in the case of a significant safety event being identified through HFDM, a crew will often be encouraged to submit an air safety report (ASR) into the SMS, where an HFDM programme can support an investigation.

HFDM can also contribute to other parts of the SMS framework by supporting safety performance monitoring (SPM), creating safety performance indicators (SPIs), informing a training-needs analysis (TNA) and feeding safety promotion material.

IOGP Report 690[9] specifies that *“the aircraft operator uses HFDM analysis, wxithin its SMS to assist with the identification of specific risks in the conduct of flight procedures.”*

The European Operators FDM (EOFDM) Forum offers guidance on integrating FDM into the SMS[12] and the BARS *Offshore Helicopter Operations Standard*[13] notes that

*“For long-term contracts the aircraft operator must have a Flight Data Monitoring (FDM) program as part of its SMS to systematically analyze and make pro-active use of digital flight data from routine operations to reduce risk and provide operational feedback.”*

## 2.4 HFDM and Just Culture

The ICAO *Safety Management Manual*[11] identifies the need for a positive safety culture, saying *“Safety culture is arguably the single most important influence on the management of safety”*.

In the 1990s, the concept of a ‘no-blame culture’ was widespread (as distinct from the largely punitive cultures that it sought to replace). It recognised that most ‘unsafe acts’ were ‘honest errors’ whose perpetrators were not blameworthy, and where no benefit would be gained from punishment. However, this concept failed to address wilful dangerous behaviour or distinguish between culpable and non-culpable unsafe acts[14].

In part to address this shortfall, Reason[15] defined the concept of a ‘Just Culture’ as

*“an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information – but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour.”*

This concept maintains the no-blame concept but does not tolerate gross negligence, wilful violations and destructive acts, while recognising that only a very small proportion of human actions that are unsafe are deliberate.

Any HFDM programme should be entirely consistent with the Just Culture established in the organization through the SMS.

The latest version of ICAO *Annex 6*[16] contains a change in language from requiring a Flight Data Analysis Programme to be “non-punitive”, to the definition given in Appendix 3 of ICAO Annex 19[17]:

*“States shall ensure that safety data or safety information is not used for:*

*a) disciplinary, civil, administrative and criminal proceedings against employees, operational personnel or organizations;*
*b) disclosure to the public; or*
*c) any purposes other than maintaining or improving safety; unless a principle of exception applies.”*

With respect to safety culture around HFDM, guidance material to the FDM requirement in the EU rules for air operations[18] states that:

*“Indicators of an effective safety culture typically include:*

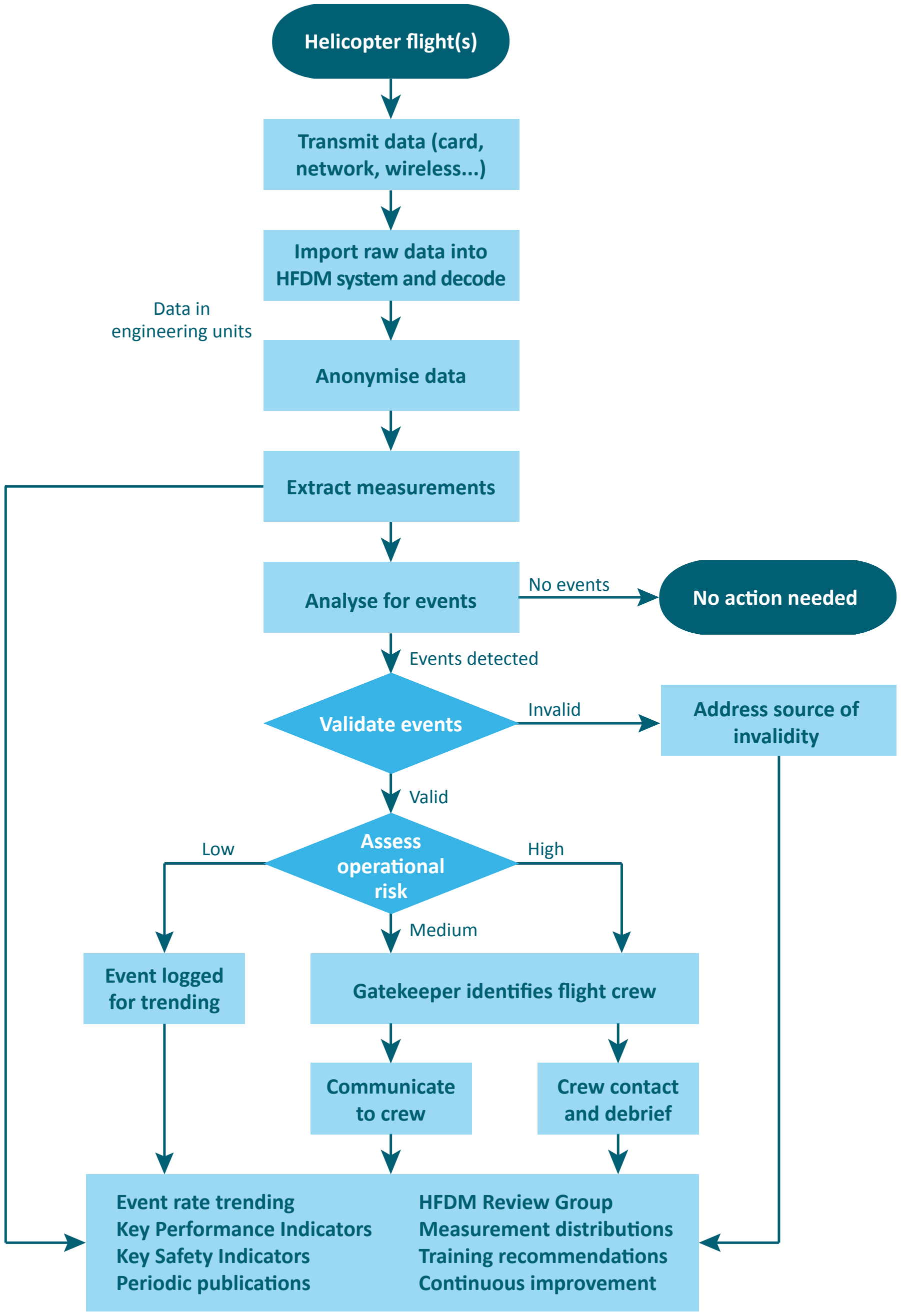
*(i) top management’s demonstrated commitment to promoting a proactive safety culture;*
*(ii) a non-punitive operator policy that covers the FDM programme;*
*(iii) FDM programme management by dedicated staff under the authority of the safety manager, with a high degree of specialisation and logistical support;*
*(iv) involvement of persons with appropriate expertise when identifying and assessing the risks (for example, pilots experienced on the aircraft type being analysed);*
*(v) monitoring fleet trends aggregated from numerous operations, not focusing only on specific events;*
*(vi) a well-structured system to protect the confidentiality of the data; and*
*(vii) an efficient communication system for disseminating hazard information (and subsequent risk assessments) internally and to other organisations to permit timely safety action.”*

This is a subset of the guidance on Safety Culture contained within the ICAO Manual on Flight Data Analysis Programmes[4].

Some cite as an advantage of HFDM, its ability to detect events in organizations without a good reporting culture. However, without the appropriate safety culture in place, any HFDM programme cannot hope to be effective. Similarly, any abuse of that culture, and the trust that accompanies it, by the HFDM programme will have an enormous impact on the programme and the organization as a whole. It is crucial that any HFDM programme commands and maintains the trust of the workforce.

## 2.5 Overview of HFDM System Process

The figure opposite outlines the key stages of the HFDM process. For clarity this flowchart shows only the HFDM components rather than the full interaction with the operator's SMS, see[2,12] for example.



# Section 3 Regulation

# Section 3
# Regulation

## 3.1 Requirement to Record Flight Parameters

While the requirement for a helicopter to carry a Flight Data Recorder (FDR) is independent of any HFDM programme, the requirement to carry an FDR implies that the flight parameters are concentrated before being recorded, which makes it possible to collect them for HFDM purposes. Therefore, it is relevant to be aware of the regulation around the requirement to carry a recorder. In addition, the presence or absence of an FDR is sometimes referred to in regulation relating to HFDM (e.g. *SPA.HOFO*[19], Annex 6[16]).

### 3.1.1 Flight Recorder Standards

The most commonly referenced standards for Flight Data Recorders are ED-112A[20] (or TSO C124c[21]) for crash-protected airborne recorder systems, and ED-155[22] for lightweight flight recording systems. Both documents contain a table of parameters to be recorded (see also *Section 5.2*).

### 3.1.2 ICAO Annex 6

ICAO *Annex 6, Part III*[16] provides Standards and Recommended Practices for Helicopters and Section III, Chapter 4.7 describes the requirement to fit an FDR:

*"4.7.1.1 – Applicability*

*4.7.1.1.1 – All helicopters of a maximum certificated take-off mass of over 3175 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2016 shall be equipped with an FDR which shall record at least the first 48 parameters listed in Table A4-1 of Appendix 4.*

*4.7.1.1.2 – All helicopters of a maximum certificated take-off mass of over 7000 kg, or having a passenger seating configuration of more than nineteen, for which the individual certificate of airworthiness is first issued on or after 1 January 1989 shall be equipped with an FDR which shall record at least the first 30 parameters listed in Table A4-1 of Appendix 4.*

*4.7.1.1.3 – Recommendation – All helicopters of a maximum certificated take-off mass of over 3175 kg, up to and including 7000 kg, for which the individual certificate of airworthiness is first issued on or after 1 January 1989, should be equipped with an FDR which should record at least the first 15 parameters listed in Table A4-1 of Appendix 4.*

*...*

*4.7.1.3 – Duration – All FDRs shall retain the information recorded during at least the last 10 hours of their operation."*

The Annex also lists parameters to be recorded – see *Section 5.2*.

### 3.1.3 Summary

*Appendix 13.1* contains the specific guidance issued by EASA, FAA and Transport Canada regarding fitment of FDRs. Table 1 below summarises the guidance for some typical aircraft in operation in Oil and Gas passenger transport, disregarding the date of the individual certificate of airworthiness, based on Maximum Certified Take-Off Mass (MCTOM) and Maximum Operational Passenger Seating Configuration (MOPSC).

| | Typical MCTOM (kg) | Typical MOPSC | ICAO | EASA | FAA | TC |
|---|---|---|---|---|---|---|
| **Bell 407** | 2,268 | 6 | - | o | - | - |
| **AW 169** | 4,800 | 10 | o | • | • | • |
| **Airbus H155** | 4,850 | 14 | o | • | • | • |
| **Bell 212** | 5,080 | 14 | o | • | • | • |
| **Sikorsky S-76 (D)** | 5,386 | 9 | o | • | - | - |
| **Bell 412 (EP)** | 5,398 | 14 | o | • | • | • |
| **AW 139** | 6,400 | 15 | o | • | • | • |
| **Airbus H175** | 7,500 | 18 | • | • | • | • |
| **AW 189** | 8,300 | 19 | • | • | • | • |
| **Airbus H225** | 11,000 | 25 | • | • | • | • |
| **Sikorsky S-92** | 12,020 | 19 | • | • | • | • |

*Table 1 – Requirement to fit a Flight Data Recorder*
*(• = required, o = recommended, - = not required)*

### 3.1.4 Lightweight Recorders and Rotorcraft

CAT.IDE.H.191[23] mandates the fitment of a lightweight flight recorder for CAT helicopters with a MCTOM of 2,250kg or more and an individual Certificate of Airworthiness on or after 5 September 2022. In addition, EASA revised a Safety Information Bulletin (SIB)[24] which encourages the fitment of flight data recorders to light rotorcraft.

## 3.2 Requirement for an HFDM Programme

Not all States have requirements for, or offer guidance on, running an HFDM programme. Some of the better-known guidance and regulation is described below.

### 3.2.1 ICAO

ICAO *Annex 6 - Part III*[16] states in Section II that:

> *"1.3.1* ***Recommendation****.– The operator of a helicopter of a certified take-off mass in excess of 7000 kg or having a passenger seating configuration of more than 9 and fitted with a flight data recorder should establish and maintain a flight data analysis programme as part of its safety management system."*

The Annex also refers the reader to the ICAO *Manual on Flight Data Analysis Programmes*[4] for information on establishing a programme and ICAO *Annex 19*[17] for guidance on the protection of data.

### 3.2.2 EU Rules for Air Operations

EU *Rules for Air Operations* SPA.HOFO[19] contains requirements applicable to Helicopter Offshore Operations and, specifically, SPA.HOFO.145 *Flight Data Monitoring (FDM) system* states that:

*"(a) When conducting CAT operations with a helicopter equipped with a flight data recorder, the operator shall establish and maintain a FDM system, as part of its integrated management system, by 1 January 2019.*

*(b) The FDM system shall be non-punitive and contain adequate safeguards to protect the source(s) of the data."*

AMC1, GM1 and GM2 to SPA.HOFO.145 provide additional means of compliance and guidance on the form the programme should take. GM2 includes a list of example HFDM events that is taken from the Global HFDM guidance[25].

### 3.2.3 FAA

FAA Advisory Circular 120-82[1] gives *"guidance on one means, but not necessarily the only means, of developing, implementing, and operating a voluntary Flight Operational Quality Assurance (FOQA) program that is acceptable to the Federal Aviation Administration (FAA)."*

The document notes that FOQA is a voluntary safety programme and that approval of that programme by the FAA is only required if protection from enforcement is sought, under 14 CFR part 13, section 13.401.

The document focuses predominantly on fixed-wing but much of the content is also relevant to an HFOQA / HFDM programme.

### 3.2.4 CASA

The Australian Civil Aviation Safety Authority (CASA) Part 119[26] 119.195 requires that an Australian air transport operator must have a flight data analysis programme if they are operating a rotorcraft

*"(i) with a maximum take off weight of more than 7,000 kg; or*

*(ii) with a maximum operational passenger seat configuration of more than 9 seats and that is required, under these Regulations, to be fitted with a flight data recorder."*

The regulation also gives further details about the form the programme should take. CASA Civil Aviation Advisory Publication CAAP SMS-4(0) gives supporting *Guidance on the Establishment of a Flight Data Analysis Program (FDAP) – Safety Management Systems (SMS)*[27]. The guidance predominantly concerns fixed-wing operations.

## 3.3 Other Guidance

*CAP 739 – Flight Data Monitoring*[2] from the UK CAA is a comprehensive reference for FDM, including some details specific to HFDM. It was last updated in 2013.

The *Industry Best Practice*[25] from the Global HFDM group offers useful guidance that is specific to helicopter operations. It was last updated in 2012.

The *Basic Aviation Risk Standard* (BARS) for *Offshore Helicopter Operations*[10] and the *BARS OHO Implementation Guide*[13] published by the Flight Safety Foundation includes Flight Data Monitoring as part of an effective SMS and also as part of a minimum mission fit.

The European Operators Flight Data Monitoring (EOFDM) Forum[28] has produced a number of FDM industry good practice publications, including:

- *Preparing a Memorandum of Understanding for an FDM Programme*[29]
- *Key Performance Indicators for a Flight Data Monitoring Programme*[30]
- *Breaking the Silos: Integrating Flight Data Monitoring into the Safety Management System*[12].

The group has also published other guidance such as:

- *Review of Accident Precursors*[31]
- *Guidance for the Implementation of FDM Precursors*[32]

which, although aimed at fixed-wing operations, offers useful concepts for HFDM. They also publish presentations delivered at previous FDM conferences[33].

The ICAO *Manual on Flight Data Analysis Programmes*[4] offers useful guidance on all aspects of an FDM programme.

## 3.4 IOGP Guidance

The International Association of Oil & Gas Producers (IOGP) represents the global upstream oil and gas industry. IOGP Report 690[9] describes *Offshore Helicopter Recommended Practices* to assist in the management of offshore commercial helicopter transport operations.

The guidance in Report 690 that relates to HFDM (mostly contained in Section 8 of 690-2: Aircraft Operations) is included throughout this report in highlighted boxes, as shown below.

IOGP Report 690[9] specifies that:

*"A Helicopter Flight Data Monitoring (HFDM) programme is established and documented, and is aligned with the HeliOffshore HFDM Recommended Practices (HO-HFDM-RP-v1.0)."*

# Section 4 Legal Agreements and Data Protection

# Section 4
# Legal Agreements and Data Protection

The success of any HFDM programme lies in the level of trust and support it commands within the organization. Absolutely central to the issue of trust is the confidentiality, anonymity and data protection within the programme.

## 4.1 Staff Agreements

An HFDM programme must contain a policy defining how the flight data that is acquired will be treated, often referred to as a 'confidentiality agreement', 'Memorandum of Understanding' or similar. This document is part of an operator's Safety Management System (SMS), whose specific manuals and documents it should be linked to, but it can also be regarded as a standalone document in support of the HFDM programme.

The confidentiality agreement must clearly define the responsibilities of the operator and its employees with respect to the processing, analysis, handling and retention of flight data. It should also layout the conditions and process for making contact with a crew. This agreement should be signed by the highest levels of senior management on behalf of the operator and also by any individual coming into contact with data from individual flights.

As part of the acceptable means of compliance to *ORO.AOC.130*[34], it is specified in subpart (k):

> *"The procedure to prevent disclosure of crew identity should be written in a document, which should be signed by all parties (airline management, flight crew member representatives nominated either by the union or the flight crew themselves). This procedure should, as a minimum, define:*
>
> *(1) the aim of the FDM programme;*
> *(2) a data access and security policy that should restrict access to information to specifically authorised persons identified by their position;*
> *(3) 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 person(s) need not necessarily be the programme manager or safety manager, but could be a third party (broker) mutually acceptable to unions or staff and management;*
> *(4) the data retention policy and accountability, including the measures taken to ensure the security of the data;*
> *(5) the conditions under which advisory briefing or remedial training should take place; this should always be carried out in a constructive and non-punitive manner;*
> *(6) the conditions under which the confidentiality may be withdrawn for reasons of gross negligence or significant continuing safety concern;*
> *(7) 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*
> *(8) the policy for publishing the findings resulting from FDM."*

It is beyond the scope of this document to discuss in detail the content of the confidentiality agreement as it must be tailored to each individual operator's needs. For example, one significant difference between operators is whether the pilots operate in a unionised or non-unionised environment, possibly leading to different procedures around the handling of HFDM data. This may require operators to produce different confidentiality agreements for different regions of operations or different Air Operator's Certificates (AOCs).

However, examples of typical agreements and guidance around the necessary considerations are available:

- The International Helicopter Safety Foundation (IHSF) provide an example Pilot Agreement as part of their HFDM toolkit[3]
- Appendix D of CAP 739[2] gives a Sample FDM Procedural and Confidentiality Agreement but this is relatively limited in scope.
- Working Group C of the European Operators Flight Data Monitoring Forum has produced a document entitled *Preparing a Memorandum of Understanding for an FDM Programme*[29] to assist in preparing a document. It deals with the 8 areas listed above, in turn.

If an external HFDM provider is used (see *Section 5.1.2*) they should be a party to the confidentiality agreement with specific provisions about their responsibilities.

If the operator is taking part in a data-sharing forum (see *Section 10.3*), it would be helpful to include that in the confidentiality agreement.

Very occasionally, some feel that the level of data protection given to HFDM data is excessive or onerous despite the fact that a data protection policy need not be complicated or expensive. In those cases, it may be useful to draw the analogy for a desk-based worker:

*Imagine there were a device on your desk continually recording your actions and decisions throughout the working day, with the data permanently stored and available to be reviewed by the organization. What protections would you want on the organization's ability to identify you and review your individual actions?*

## 4.2 Deidentification of Data

One of the core protection mechanisms for HFDM data is to store and access it in deidentified form, meaning that the flight data cannot be linked to individual flight crew by the person viewing the flight data. This can be achieved in a number of ways such as removing aircraft registrations, specific dates or other such data. As well as protecting the individual flight crews, deidentification also limits the potential influence of bias (either conscious or subconscious) on the judgement of analysts (whether positive or negative) about an event.

It is vital that the senior management of the operator shows its full support for the HFDM programme and gives complete assurance that the anonymity of flight data will be respected, with any exceptional circumstances being handled as described in the HFDM programme manual. The ICAO *Manual on Flight Data Analysis Programmes*[4] notes that a policy on *"data de-identification is an absolutely critical area that should be carefully written down and agreed to before it is needed in extreme circumstances."*

The ability to link a flight with an individual should be restricted to the Gatekeeper (see *Section 6.2*). The confidentiality agreement must define under what circumstances anonymous flight data can be 'reidentified', the process for doing that and the permitted uses of the identified data.

Operators should be careful to consider at what point flight data should be deidentified and ensure that the relevant confidentiality agreement is signed and observed by all relevant staff. For example, a maintenance engineer with responsibility for uploading HFDM data and with access to the HFDM system may be able to relate flight data to an individual.

## 4.3 Protection of Data and the General Data Protection Regulation

With respect to storage of flight data and analysis results, the ICAO *Manual on Flight Data Analysis Programmes*[4] recommends an 'online' and 'offline' strategy where the *"most recent flight data and exceedances are normally kept readily available to allow fast access during the initial analysis and interpretation stages. When this process is completed it is less likely that additional data from the flights will be required so the flight data can be archived. Exceedances are usually kept on line for a much longer period to allow trending and comparison with previous events."* However, this guidance is motivated in part by data volume and so may become less relevant as data capacity and computing speeds increase.

ICAO *Annex 6*[16] states that *"as of 7 November 2019, a flight data analysis programme shall contain adequate safeguards to protect the source(s) of the data in accordance with Appendix 3 to Annex 19."* This Appendix in Annex 19[17] offers useful guidance on the conditions for protecting and releasing data. SPA.HOFO[19] also makes reference to *"adequate safeguards"*.

If the operator plans to release any data in support of external programmes such as operational research, evidence-based training (EBT), safety investigations or data-sharing forums (see *Sections 8.1, 10.1 and 10.3*) it should conform with the HFDM programme manual, ideally with a dedicated section detailing the data allowed to be released.

In Europe, the General Data Protection Regulation (GDPR) was put into effect on May 25, 2018. Full details of the regulation are available[35] but in summary, the GDPR imposes obligations onto organizations anywhere about how they process, handle and protect personal data related to people in the EU.

Some operators do not consider deidentified HFDM data to constitute personal data (since it requires additional crewing data to 'decode' it or because it is not considered to be personal data) but this will need to be an individual assessment by each organization's legal function.

See also *Section 8.5* on retention of flight data.

# Section 5 HFDM Hardware and Software

# Section 5
# HFDM Hardware and Software

## 5.1 Choice of System

An operator's choice of HFDM system will depend greatly on their individual situation including: size of organization; number of aircraft; aircraft types; and geographical locations. *Appendix 13.2* contains a list of some of the more well-known vendors of HFDM solutions.

One of the fundamental choices when selecting a system is whether to run the system in-house, use an external provider or use a hybrid system combining both approaches. There are positives and negatives to each approach, some of which are described below.

### 5.1.1 In-house System

In this type of system, the operator is in charge of all aspects of the system from data acquisition to results feedback and including other activities such as: event setting, data management and software installation.

One of the strengths of this approach is the ability for the operator to customise and manage the programme to suit their needs, including defining HFDM events that are relevant for the type and context of operation and aligned with the safety priorities as identified by the SMS. This approach will often suit larger operators and/or those with more experience in HFDM.

One downside of this solution is that support from software providers can be limited, particularly when establishing and defining event sets, so it can be difficult for operators to have confidence in their programme. While the software supplier may offer a 'library' of events to select from, it falls to the customers to modify them to suit their operation.

Smaller operators may not have the organizational structure to support an in-house programme.

### 5.1.2 Hybrid Provision

There is a wide range of solutions which fall between the two options of full in-house and full external provision, which some operators choose to adopt.

For example, one approach might be to have an external provider collecting, processing and analysing data for events which are then fed to internal employees to analyse in detail, decide on a course of action and, if appropriate, discuss with a crew. This would probably require the HFDM events to be adapted to the specific operator and its safety risk priorities, and for the HFDM staff at the operator to have a clear understanding of the trigger logic and the limitations of the HFDM event.

Another option is to partner with a software provider but perform all of the analysis in-house.

### 5.1.3 External Provider

When using an external provider to deliver the majority of the HFDM programme, the bulk of the work will be carried out by the external provider. This would often include the software maintenance, validating and analysing events and feeding back results. Typically, any crew contacts would be handled by the operator, with support from the external provider.

Although the programme may be delivered by an external provider, it remains the responsibility of the operator. ICAO *Annex 6*[16] notes that *"The 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."* This means that analysis by the provider will be against events sets for which the operator has responsibility.

However, the precise form of the provision is less important than ensuring that the HFDM programme is effective

## 5.2 Aircraft Types

The fundamental difference between aircraft types is most easily described in terms of analogue and digital instruments:

- in general, aircraft using digital instruments often employ data busses from which parameters can be selected for recording to a Digital Flight Data Recorder (DFDR), Health and Usage Monitoring System (HUMS) unit or a Quick Access Recorder (QAR), making extraction of data for use in an HFDM programme much easier. Many larger, more modern aircraft will be in this category (see *Section 3.1*).
- aircraft with analogue instruments often have little or no provision for extracting digital signals for recording. Although the aircraft may still have an FDR fitted, it might be designed specifically for the aircraft in question.

All system installations must be approved in accordance with the applicable regulatory authorities' certification requirements. They must be fit for purpose and cause no detriment to the aircraft and the safety of its systems. Additionally, the HFDM installation must have no effect on the data storage within the FDR, if fitted.

The range of data parameters recorded will directly affect the scope and complexity of the monitoring that can be carried out and the number and range of events that can be monitored. Regardless of the type of system installed, the installation should provide parameters which are appropriate for the events being monitored and the analysis being performed.

AMC1.1 to CAT.IDE.H.190[36] provides a list of parameters that should be recorded on the FDR of a helicopter having a MCTOM of more than 3,175 kg and first issued with an individual CofA on or after 1st January 2016 and before 1st January 2023 and this is reproduced in *Appendix 13.3*.

*Annex 6 – Part III*[16] provides a similar list, with further details such as minimum sample rate, range and resolution. EUROCAE document ED-112A[20] provides a similar list as does FAA §135.152 *Flight data recorders*[37]. However, even with modern aircraft, these lists are not always fully satisfied.

## 5.3 On-board Systems

The aircraft must have on-board facility for storing flight data such as:

- a memory card in a Quick Access Recorder (QAR);
- a storage card in a HUMS system or data acquisition unit; or
- embedded memory in a DFDR.

The recording medium on the aircraft should allow the flight data produced by that system to be stored for the complete period before scheduled download. Ideally the recording duration will be more than 25 hours of continuous flight data with daily download, to ensure data is not lost. There should be a convenient method of transferring data from the aircraft to the operator's, or external provider's, computer systems.

The system performing the recording should minimise any buffers before recording to the medium in order to guard against data loss in the case of sudden/inadvertent power loss. As part of the investigation into the accident to G-REDL in 2009, the UK AAIB found that the Card Quick Access Recorder used for HFDM (referred to as HOMP in the report) *"contained a memory buffer which stored flight data for up to two minutes before being written to the removable card. If power to the memory is lost, then its contents will be lost, including up to two minutes of flight data."* This prompted Safety Recommendation 2011-047 *"that the Civil Aviation Authority update CAP 739, and include in any future Helicopter Flight Data Monitoring advisory material, guidance to minimise the use of memory buffers in recording hardware, to reduce the possibility of data loss."*[38].

## 5.4 Data Transfer

Once the flight data has been acquired within the helicopter, it is necessary to transfer the data from the aircraft into the operator's systems. Various means exist for achieving this including:

- swapping flash memory devices such as PC cards, memory cards etc.;
- wireless transfer via Wi-Fi or cellular data network; and
- direct cable connections.

Regardless of the means of transfer, the system should have the facility for operator personnel to download the data at the operating base and this should be carried out at least on a daily basis. Special attention should be given to data security and anonymity at this point since the flight data is still identifiable with respect to the flight crew, albeit often encoded by the data frame (see *Section 5.5*).

Each operating base should have the facility to transfer data from the aircraft into the operator's or external provider's system to make it available for analysis. If a temporary remote base is being operated from, the operator should make arrangements that allow data to be transmitted into the system from that base for analysis.

IOGP Report 690[9] specifies that:

*"HFDM data is downloaded from all aircraft daily as a minimum and a process for the review of the data is in place."*

The rate of successful data download from the fleet should be measured and reported as a key performance indicator (KPI), either as a percentage of flights, sectors, take-offs or similar, or as a percentage of flight hours. This requires a means of calculating flights or flight hours that is independent of HFDM data. A data recovery rate of 95 percent is a reasonable target for a mature programme.

IOGP Report 690[9] specifies that:

*"The data download rate as a Key Performance Indicator (KPI) is tracked and the target is 95%."*

The EOFDM Forum also suggested[30] that *"time between actual occurrence and first detection by the FDM software"* be used as a KPI; this gives an indication of how effective the HFDM programme is in capturing events in a timely manner.

There are now a number of systems capable of supplying some flight data parameters in near real-time including: via the ADS-B protocol; using OEM solutions such as Sikorsky's *Real-Time HUMS*; and through third-party solutions such as *Spidertracks*. However, it is important to verify that any solution to be used to implement HFDM is fit for that purpose, not just for, say, flight-following. HFDM requires a very specific and reliable data set whereas in flight following: data drop out of a few seconds may be entirely acceptable; required data resolution and sampling rates may be low; and data may not be routinely recorded.

## 5.5 Ground Hardware and Software

Depending on the aircraft system being used (e.g. DFDR, HUMS, QAR etc.) the data may be stored in a format that requires a decoder in order to read it. The document for decoding is often referred to as the LFL (Logical Frame Layout) or DFL (Data Frame Layout) which describes how the data is recorded and how to convert it to engineering units, and can be unique to a specific airframe. (As an aside, for FDRs it is a requirement that operators are able to provide the LFL/DFL on demand for each aircraft in their fleet to allow accident investigators to read the FDR in the case of an accident). Most providers will incorporate the LFL/DFL into their HFDM software when an aircraft is 'set up' in the system.

There are different ground hardware configurations available / required by different HFDM systems:

- Some HFDM systems use specific computer hardware for the ground station - this guarantees software / hardware compatibility but can restrict flexibility, limit access and increase costs.
- Some HFDM systems use generic hardware with local software installations - this gives operators greater flexibility and may facilitate wider access but it may also give rise to software / hardware incompatibilities.
- Some HFDM providers use web-based services to give access to their systems - these systems are often independent of operating system or browser type and can enable access for a wider group and in any location. However, there is an obvious requirement for an active internet connection to gain access to the system.

The data analysis system and software used should have the following capabilities:

- the ability to display information in a logical and user-friendly way;
- the ability to programme a range of alert detection thresholds to generate events when parameters exceed preset values, covering aircraft flight manual limitations, operator flight profile requirements and SOPs;
- the ability to enable detailed analysis of the flight data; and
- the ability to extract values from all flights (often termed 'measurements', 'parameters', 'state values' or similar – measurements will be used from this point) to provide long-term trend analysis of data.

This can be achieved either within the HFDM software package or through the use of additional tools. One example might be using software tools such as such as R and Python.

## 5.6 System Serviceability

The operator's flight operations, maintenance and dispatch functions will ensure that the aircraft is ready for use in accordance with the operator's Minimum Departure Standards (MDS) or aircraft's Minimum Equipment List (MEL).

It is important to note that the CVFDR (or CVR and FDR if separate units) is a separate hardware item required in the MEL which provides redundancy if needed to investigate an issue.

With respect to system serviceability, the HFDM programme should focus on whether the data was recorded, downloaded and processed successfully. Any issues with the aircraft equipment should be relayed through the appropriate operator function. Operators should take measures to assure the availability and functionality of the HFDM analysis system using approaches such as service agreements with the equipment and software OEMs or the provision of back-up equipment.

IOGP Report 690[9] specifies that:

*"A serviceability policy for both airborne and ground station equipment has been established. System unserviceability is not to exceed 25 flight hours between data downloads."*

# Section 6 Organizational Structure

# Section 6
# Organizational Structure

The organizational structure supporting the HFDM programme may look different from one company to the next, often varying with the operator's size, number of aircraft and level of outsourcing.

No matter how the programme is managed, the functions described in the roles below will need to be performed. However, the size of the organization will affect the number of individuals that cover these functions with some roles being filled by the same person in small organizations.

> IOGP Report 690[9] specifies that:
>
> *"Personnel are appointed to fill specific positions within the HFDM programme (such as analyst, gatekeeper or pilot liaison) and training is provided for all personnel appropriate to their responsibilities."*

Any organizational structure must provide sufficient cover to be able to accommodate staff working patterns, leave, illness, absence and turnover.

Employees in these positions may be full-time or part-time as appropriate, or the majority of the programme could be managed by a third party (see *Section 5.1*).

## 6.1 HFDM Programme Manager

The function of this role is to manage and oversee the programme including:

- the collection, processing and analysis of flight data;
- monitoring the download rates and linking to maintenance if necessary;
- the feedback of results; and
- the completion of follow-up activities.

It is the responsibility of the Programme Manager to ensure that results are provided in a timely way and in context, thereby allowing the company management to make informed decisions about the safety and effectiveness of the operation.

If the size of the organization allows, it may be helpful for this role to be filled by someone from outside the Senior Management Team to reinforce the independence of the role.

In a fully-outsourced solution, it is this role that would provide the link between the service provider and the operator to ensure the system is effective.

Some operators choose to fill this role with an experienced pilot; while this is not an essential requirement, a strong knowledge of operations or access to an experienced pilot is crucial.

In smaller operators where the Programme Manager is part of the core management team, that individual may be restricted from access to the identified data, but retain overall management responsibilities for the system and for the use of deidentified data. In a very small operation, the Programme Manager may actually be the owner or Managing Director/CEO of the operator. In such cases, confidentiality is very difficult, if not impossible, to achieve. However, HFDM systems in this type of situation can still be very effective and retain the support of the staff, particularly where there is a Just Culture, or 'Just and Fair' Culture, in the organization.

## 6.2 Gatekeeper

This role functions as the link between anonymised flights and events and the specific flight crew involved. As such, this role is trusted with confidential data and is the only role able to connect the de-identified data to the specific flight crew to whom it relates. For this reason, the confidentiality agreement signed by staff in this role must be comprehensive.

Even in small organizations, it might be advantageous to separate this function from analysis roles in order to preserve flight crew confidence in the anonymity of the system.

## 6.3 Data Analyst(s)

The role of the data analyst is to use the software to achieve tasks such as:

- coding and validating events in software;
- implementing event thresholds;
- identifying exceedances;
- validating the credibility of events; and
- producing output from the programme for feedback, including statistics for internal use and wider distribution.

The data analyst(s) should be skilled in using the chosen software to meet the operator's needs which will vary depending on the level of outsourcing, if any.

In order to enable effective validation of events (see *Section 7.2*), and to also allow customisation of the process to an individual operator's requirements, it is recommended that this capability is normally performed in-house. However, provided some level of in-house analysis capability exists, the primary or initial data analysis could be performed by a third party.

## 6.4 Pilot Liaison

It is the responsibility of the pilot liaison (sometimes referred to as pilot representative) to contact a crew (in consultation with the Gatekeeper when that role is filled by a different person) when an exceedance has been identified and to explain and review that event, using playback and analysis software where appropriate. The pilot liaison will also relay any comments from the crew to the HFDM programme.

In a unionized environment, a union representative may be required or requested by the crew to attend any crew meeting.

Although it is not essential, this role will often be filled by an experienced and trusted pilot and it may be beneficial if it is a TRE/TRI so they are able to provide training advice. In some organizations the Gatekeeper also holds this post.

## 6.5 HFDM Review Group

The role of the HFDM Review Group includes:

- periodic review of deidentified HFDM data findings;
- determining and periodically reviewing the alert detection thresholds (see *Section 7.4*);
- making recommendations for changes to procedures and training to the accountable manager;
- investigation of significant events discovered by the HFDM Programme; and
- making the decision to remove the protection of confidentiality in cases of gross misconduct or continued non-compliance with SOPs. (In such cases, crews would normally be interviewed and details may be passed to company management for action as necessary. In this way, the HFDM Programme remains 'Just' / 'Just and Fair' as opposed to 'non-punitive'.)

The HFDM Review Group should include those members of the company who have responsibility for operational standards and flight safety. In larger organizations this could include:

- Chief Pilot;
- Head of Flight Standards;
- Flight Operations Manager;
- Flight Safety Officer; and
- Training Captains

or equivalent roles in a smaller organization. Depending on the organization, this group may interact with, feed into or even be part of the safety action group (SAG), the safety review group (SRG), a Standards and Review group or others.

IOGP Report 690[9] specifies that:
*"An HFDM review group meets at regular intervals to:*
- *Validate the reports, including a periodical review of de-identified HFDM data findings.*
- *Investigate significant events identified by the HFDM Programme.*
- *Review KPIs and trends*
- *Make recommendations for suggested changes to operational procedures or the training syllabus and tracks their implementation.*
- *Periodically determine the effectiveness of thresholds."*

## 6.6 Personnel Training

HFDM training can take many forms ranging from general Flight Data Monitoring training (often having an emphasis on fixed-wing operations) to the use of specific software.

Training should ideally be provided for all HFDM posts, appropriate to their level of use. The data analyst needs to have 'relevant expert' levels of skill in working the systems, as should the HFDM Programme Manager. The pilot liaison position will require knowledge of the review/playback systems and must be able to interpret data provided by the analyst. In normal operations, line pilots or line maintenance staff are likely to need only sufficient knowledge to download data.

### 6.6.1 General Training

Generic courses should include a broad syllabus including subjects such as:
- regulatory frameworks;
- the role of FDM in a Safety Management System;
- FDM technology;
- event-setting and validation;
- use of measurements;
- interpretation of data;
- the role of animation and visualisation in presenting data; and
- legal requirements.

*Appendix 13.2* includes details of some of the general courses available globally.

### 6.6.2 Specific Software Training

Ideally, any specific software training should be provided directly by the vendor or their associate. Alternatively, if necessary, it can be given by someone in the organization who has taken the specific vendor's training.

*Appendix 13.2* includes details of some of the software-specific training courses available.

Operators should be aware that some training on software only contains information on how to make the software behave in a particular way and does not give guidance on the fundamental principles, goals or implementation of an HFDM programme.

### 6.6.3 Information for Flight Crews and Maintainers

It is beneficial for flight crews to understand the purpose and operation of the HFDM programme in order to build confidence in the programme. Similarly, it may be beneficial for maintainers to understand the reasons for collecting data and to see that HFDM can assist maintenance programmes as well as flight operations.

The HFDM Programme Manager should welcome queries from crews and any request to view their data or understand more about the system should be treated positively. It may be appropriate to hold internal sessions to raise staff awareness of the aims and protections within the HFDM programme.

## 6.7 Size of Organization

As described above, the way in which the functions described in the roles are performed, will vary from operator to operator.

The allocation of sufficient resources to complete the functions is crucial to the effectiveness of the system. It is very important that the collected flight data be regularly reviewed and the necessary resources should be made available to do so. The inclusion of these tasks into an individual's job description will help to allocate responsibility for the various roles. To enable this, larger organizations processing their data in-house should strive to employ full time, dedicated data analysts.

All staff involved in any way with a company's HFDM Programme should be bound by the conditions laid down in any confidentiality agreements in force.

# Section 7 Data Analysis

# Section 7
# Data Analysis

This Chapter describes the process of collecting, analysing and validating data and events within an HFDM programme.

## 7.1 Collect and Process Flight Data

The first stage in the analysis process is to collect the flight data from the aircraft as described in *Section 5.4 - Data Transfer* and convert it into engineering units as described in *Section 5.5 - Ground Hardware and Software*.

The operator may choose to screen for quality and/or clean the data at this point to ensure the capture, decode and data quality (such as absence of noise, dropouts, spikes) is suitable. This initial screen can help catch problems before the data is added to the database.

By this point in the process, the data should be anonymised in line with the guidance in *Section 4*.

Once the data is available in the HFDM system, it must be segmented into separate flights, which is usually an automated process within the software. However, this process is not always trivial, particularly if a Weight On Wheels (WOW) or similar discrete is not available. It may be necessary to combine parameters (e.g. Ground Speed and Total Torque) to define landing points for an aircraft without a WOW sensor.

## 7.2 Event Analysis

Once the data is available as individual flights in engineering units, it can be analysed for 'events'. These are areas of interest (often exceedances) detected within the flight data, based on pre-defined algorithms. These may be as simple as a single parameter exceeding a threshold value (e.g. airspeed exceeding $V_{NO}$) or much more complex, combining flight phases and numerous parameters (e.g. unstabilised approach). Some events contain multiple thresholds corresponding to an event 'severity', often expressed as Level 1, 2, 3 or similar – see *Section 7.3* below.

Most software providers include an initial set of events as part of their installation and setup process and these should be customised to an individual operation. As an operator gains experience and confidence in the system, they may choose to refine thresholds and expand their event set, sometimes including defining new events of their own. Any contractual agreement with an external provider should be clear about the ownership of the initial event set and any modifications made to it.

*Section 7.4* gives guidance on threshold setting and *Section 7.5* gives guidance on how to define custom events. Some OEM supplied HFDM systems have a number of pre-assigned thresholds based on Rotorcraft Flight Manual (RFM) limits. These do not normally cover operator specific flight profiles, SOPs or airmanship principles and so the operator should review and, where applicable, add these additional events.

The CAA HOMP[5] trials provided an operational event set and associated parameters. The list is reproduced in Appendix C of *CAP 739*[2].

*Appendix 13.4* gives a generic HFDM event list that has been included in the Global HFDM *Industry Best Practice*[25], the IHSF *FDM Toolkit*[3] and is included in the guidance material to *SPA.HOFO.145*[19]. This is an extensive list including more than 100 events.

However, historically in some operations, HFDM events have been added to event sets without a clear safety aim. This has led some operators to adopt a 'back to basics' approach and revisit their event sets to remove extraneous, superfluous or unfocussed events. *Appendix 13.5* presents a different approach to event definition aiming to address the core safety risks faced by a typical offshore commercial passenger transport operation.

Whichever approach is used, it is important that an operator establishes a robust set of events tailored to their unique operation and the risks it faces.

The flight data should be available for analysis within 24 hours of the flight taking place. However, due to working patterns, staff availability, time to analyse etc., operators should aim to have an initial analysis completed within 72 hours of the flight. If staff availability is a significant restriction, it might be beneficial to assign the task of checking whether any events triggers have been generated to a more available member of staff and only raising higher severity event triggers for analysis.

> IOGP Report 690[9] specifies that:
>
> *"Data is analysed for threshold exceedance events daily (operational flight days), through either operator in-house data analysis or third-party services."*

Once each flight has been analysed for event triggers, the list of events that were generated should be reviewed in order to validate that they have been generated correctly. This validation may be restricted to only higher severity event triggers, although it is important to acknowledge that unvalidated event triggers, even if they are low severity, are much less likely to be reliable. Any invalid event triggers that are identified should be used to make the event triggering logic more robust. The analysis process may include a method of excluding events triggers generated during maintenance test flights or training flights.

> IOGP Report 690[9] specifies that:
>
> *"Medium and High operational risk events which require Flight Crew contacts are validated."*

The key reason for encouraging daily analysis of HFDM data is to ensure that any higher risk events are highlighted to the flight crew as soon as possible to prevent the risk of recurrence. Timely analysis will also allow feedback to flight crew within a period where they will be able to recall the flight with clarity and assist in the analysis process.

## 7.3 Event Severity

All validated events should be assigned a severity based on the nature of the event. Many operators use three levels of severity (1/2/3, Low/Medium/High etc.). The severity rating system and follow up requirements should be described in the HFDM Manual.

> IOGP Report 690[9] specifies that:
>
> *"At least three levels of operational risk for each event (Low, Medium, and High) are set and assessed."*

There are different approaches to calculating severity, including assigning severity based on:

- amplitude of a parameter, using thresholds to categorise the proximity to an exceedance;
- duration of an exceedance; and
- combining both amplitude and duration.

The specific approach that is used will depend on the operator and also on the type of event being monitored, as not all events are suitable to have multiple thresholds assigned.

Some operators have additional levels in their system which can be used, say, to track short-term events (e.g. to monitor a specific maintenance issue) or to test new events. This approach has the benefit of not disrupting any existing event tracking or trending.

### 7.3.1 Relationship between Event Severity and Event Operational Risk

It is important to draw a distinction between the severity of an individual event and the operational risk that event presented. Severity levels are assigned according to a numerical algorithm (in order to assist analysts by highlighting certain events) but a high severity event does not imply high operational risk. However, a low severity event should imply a low operational risk for that event. If a low severity event is discovered that involved high operational risk, thresholds or events should be modified or created to capture further instances of that operational risk.

Moving from event severity to event operational risk involves a further step in which an analyst assesses the full context around an event. This process may be supported by additional procedures including review groups, written criteria or a risk assessment matrix. It is at this point that an event moves from existing solely within the HFDM system and brings in flight operations and the operator's SMS.

## 7.4 Threshold Setting

As described above, thresholds can be used to allow different event severities to be assigned. Thresholds can be established using a number of techniques, including:

**Rotorcraft Flight Manual (RFM) limitations**
Values such as $V_{NO}$ can form the basis of thresholds. However, as described above, operators may also set lower thresholds (for example 95 percent and 90 percent of exceedance value) to highlight when a limitation was close to being exceeded.

**Standard Operating Procedures (SOPs)**
Here, operators may choose to set thresholds below the SOP value to monitor how close flights came to an SOP exceedance or for trending information. However, as long as the parameter is within SOPs, it should not be considered an 'event' as such. An alternative approach taken by some operators is to set thresholds at the SOP limit, slightly above the SOP limit and well above the SOP limit.

**Operator Experience**
While values set this way may not be contained within SOPs, the expectation should be clear to flight crews though the operator training programme. This process can make use of measurement distributions (see *Section 7.5*).

> IOGP Report 690[9] specifies that:
>
> *"HFDM event thresholds are implemented based on flight manual limitations, flight profiles, and Standard Operating Procedures (SOP)."*

The level at which the thresholds are set will be affected by the operator's approach to event severity and their intended use of the events.

When setting thresholds, it is important to consider the means the flight crew have for monitoring that parameter. In analogue gauge aircraft, it may be unrealistic, for example, to expect speeds to be controlled to within, say, 5 kt and so SOPs and associated thresholds should be set accordingly.

The rationale for events and thresholds should be well-documented so that as staff change, the learning and experience can be retained in the organization.

It is important to remember that any change in thresholds will probably have an impact on trend reporting. Reanalysing historic flight data might allow some preceding event rates using the new thresholds to be calculated.

## 7.5 Analysis of All Flights

As part of the data analysis process, the software should be used to extract values at specific points (often referred to as 'measurements') from every flight processed, not just from those that raise events.

By producing distributions of these values, operators can get an insight into their entire operation rather than simply those flights where thresholds were exceeded. One benefit of this can be to highlight where threshold exceedances are part of an operation-wide trend rather than isolated exceedances. In the case of operation-wide trends, it is important to address any corrective action to the entire community rather than only those crews involved in an exceedance.

Distributions of measurements can also inform threshold setting (see *Section 7.4*).

## 7.6 Defining Custom Events

In order to monitor their individual risk profile, it is beneficial for operators to supplement any 'pre-programmed' events sets with their own custom events. Such events are typically formed from conditional logic defining flight parameters and phases of flight.

Some HFDM software segments each flight into different phases of flight such as cruise, approach, ground taxi etc. There have been attempts in the past to define these phases see[39,40] for example, however there is no universally accepted definition of the number of phases or when each phase starts and ends. For an individual operator, probably the most important aspects to ensure are consistency (ensuring all flights are analysed using the same definitions) and flight continuity (ensuring that all parts of the flight are classified into a unique phase).

Reliably identified phases can be extremely useful when defining events as they ensure that any events detected are in the appropriate flight phase rather than, say, an erroneous data spike at aircraft start. However, some less common phases, particularly those that do not appear on every flight, can be complex to identify reliably e.g. go-arounds or missed approaches.

The creation of any new event involves three parts: definition; testing; and production.

### 7.6.1 Definition

This part of the process begins by defining the operational safety risk that the event will address. Based on this definition, the parameters available from the aircraft to be used should be identified and assessed for suitability of sampling frequency and resolution.

As discussed in *Section 7.4*, thresholds can be defined in a range of ways. One particularly useful approach is to plot the distribution of operational values recorded in a sample dataset of flights which will help operators to define 'normal' operations. Based on this normal behaviour, trigger logic can be drafted that identifies the appropriate phase and/or flight conditions and monitors for threshold exceedances in that regime. It is useful at this stage to look at data from the parameters you will be using to ensure that values, signs and ranges are consistent with your expectation and whether the signal has noise, spikes or dropouts that will need to be accommodated.

As well as parameter value exceedances, it is important to consider duration of exceedance as part of the event definition. If the duration is too short, data spikes or dropouts may trigger an event. If it is too long, real events may be missed.

### 7.6.2 Testing

Having defined the trigger logic, it is crucial that any newly-defined event is thoroughly tested before being implemented.

Ideally, in the first instance, a set of flights which contain the safety event to be detected will be identified. This can sometimes be achieved by interrogating the operator's air safety reporting (ASR) system or similar. Check or maintenance flights can also be a useful source of flight data that differs from the norm. The algorithm will then be tested against that small training set to provide confidence that it is working as intended. During testing it may be appropriate to temporarily lower the event thresholds to ensure a trigger is created.

Once the desired behaviour is established, the data set should be enlarged to include routine flights. At this stage, particular attention should be paid to minimising false positives ensuring that all true positives are still detected.

The size of the data set being tested should then be increased to give a reasonable sample size (a minimum of 500 flights) to establish a representative false positive rate for the event. If an operator has small flight numbers, it may take longer to build a suitable set for testing or it may be possible to exploit shared data repositories (see *Section 10.3*).

### 7.6.3 Production

Once the testing has been completed and the event is achieving its aim, the algorithm can be moved to a 'production' phase. When this happens, the event triggers should still be carefully monitored to check for rare, unanticipated situations (e.g. sensor failures, particular flight types etc.) or other false positives.

## 7.7 Trend Analysis and Storing Results

Trend monitoring should be undertaken as a routine part of the HFDM process and this can take a variety of forms.

> IOGP Report 690[9] specifies that:
>
> *"Trend monitoring of events, including Low operational risk events, as a routine part of the HFDM process, is in place."*

The ultimate aim of HFDM data trending is to give insight into operations. Using this insight, an operator can understand their existing operation and monitor for variation or organizational drift by looking for changes in event rates over time.

One of the simplest approaches to trend monitoring is to track the rate of each event trigger per 1,000 sectors (for example) over time. However, some of the complexity in drawing effective insights comes from separating natural fluctuations, which are always particularly marked when dealing with small numbers of events, from the beginning of a trend. One way to address this is by monitoring lower level events (of which there are greater numbers) and tracking any changes. The aim of this approach is to create leading indicators rather than relying on the lagging indicator of the exceedance or bad outcome.

An extension of this approach to trending is to monitor the distribution of some flight parameters for all flights. This has the advantage of giving visibility of the complete operation, rather than just those events that are embodied, and so can help guard against overly-conservative or ineffective thresholds. Looking for changes in distributions on a month-by-month basis can be a valuable approach although it can be complicated by external factors such as weather. Some operators choose to produce these distributions as part of a monthly report or make them available through 'dashboards'.

Once an HFDM trend monitoring approach has been established, Safety Performance Indicators should be developed to help analysis and understanding. The ICAO *Safety Management Manual*[11] gives guidance on defining Safety Performance Indicators and Safety Performance Targets. The EOFDM also offers guidance on KPIs for FDM[30].

As part of the review process there should be an ongoing assessment of the aggregated risk of the operation. This risk assessment would use HFDM data but may also incorporate data from other sources such as safety reporting systems and other parts of the SMS. It is here that the overall risk is assessed including, for example, the aggregate risk associated with a high number of low operational risk events.

IOGP Report 690[9] specifies that:

*"FDM and LOSA observations are analysed collectively for added insight."*

# Section 8 Acting on Results

# Section 8
# Acting on Results

Some of the benefit of an HFDM programme comes from the assurance that the operation being monitored is operating to an unchanged standard and therefore requires no action. However, where an adverse trend, change in behaviour or individual deviation is detected, the HFDM programme can only provide benefit when those results are acted upon. That action is the subject of this Section.

> IOGP Report 690[9] specifies that:
>
> *"A process for communication and reporting of the HFDM data is established."*

## 8.1 Communication of Results

It is important to acknowledge that the majority of activity within an HFDM programme relates to overall trends within the operation. As part of this activity it is vital to communicate clearly to flight crews, and at times to the workforce in general, the results being gained from the HFDM programme.

All communication and transfer of HFDM results and information must be anonymised and conform to the operator's confidentiality agreement if trust in the system is to be maintained.

The HFDM Programme Manager should be responsible for producing regular HFDM reports which summarise event trigger activity within the organization and highlight any important trends from the analysis. These reports, which might be in the form of newsletters, should be made available and communicated to all crews and relevant departments. As well as trend information, it may be useful to describe specific individual events if they provide valuable learning. However, in these cases, fully anonymising the data is even more important.

In addition, operators should have a process in place to allow crews to request feedback from a particular flight or event. This should only be allowed for a flight which they personally operated and may include a visual playback and debrief from the local HFDM specialist. The HFDM system can also be used as a debrief tool for programmed training flights, provided this has been previously agreed and documented as a procedure.

A particularly strong link should be made between the HFDM programme and the training department. This will allow general trends that are spotted in the HFDM data to be communicated to the training department for possible inclusion in ongoing training. This 'all pilot' training to address general trends should not be confused with specific training for an individual following a specific event.

Requests for access to flight data may come from external organizations such as air traffic control (ATC), airports, customers, industry bodies and aircraft manufacturers, to inform, say, safety investigations or changes of procedures within that organization. Data should only be supplied if considered appropriate by the operator, allowed by the confidentiality agreement and should never be identifiable.

## 8.2 Crew Contacts

While the bulk of HFDM activity relates to trends and behaviours within the operation as a whole, there are times when individual behaviours need to be highlighted or discussed; this is the point of crew contacts. Crew contact is an essential component of an effective HFDM programme. If the only information received by crews were deidentified, trended data in periodic reports, then a significant proportion of the benefit of the system may be lost; individual feedback enables individual accountability. The ICAO *Manual on Flight Data Analysis Programmes*[4] comments on the need for crew contact that *"Experience has shown that this is very rarely required"*.

It is important that any crew contact is made in the context of the Just Culture concept (see *Section 2.4*) and the process should be documented in the HFDM manual. Crew contacts should be made for all validated and relevant events of medium operational risk (as distinct from event severity – see *Section 7.3.1*). This approach enables crews to be alerted to departures from operating standards and ensures those events do not become normalized. For these events, an advisory contact by email or other means may be the only action necessary.

For validated and relevant events assessed as high operational risk, a more comprehensive contact is required that involves a meeting between the pilot liaison and the flight crew involved. Depending on the pilot agreement in place, a union representative may be required to attend this meeting.

IOGP Report 690[9] specifies that:

*"Tracked Flight Crew contacts are made for every Medium and High operational risk HFDM event. For those events assessed as Medium operational risk, the crew contact is at a minimum, an advisory contact by email or other means, to alert the Flight Crew of the event. For those events assessed as High operational risk, a more comprehensive contact is made, which involves a meeting between the pilot liaison and the Flight Crew involved."*

This contact should include a review of the flight data (see *Section 8.3*) with the flight crew and the pilot liaison. The relevant points noted in the data should be discussed and the flight crew given the opportunity to provide an explanation of the context of the data. The aim is for the flight crew to assist in the analysis of the event and hopefully learn from the review.

For remote operations from temporary bases, face-to-face briefing with pilot liaison personnel and the full use of the analysis playback and review capability may not be possible; in such cases operators should make best use of available technology to communicate the event and its consequences to the crew.

The operator should also have a procedure in place to decide when information on a high risk event may be required to be communicated to other departments. Any such communication must abide by the confidentiality agreements in place for the transmission of HFDM data.

The HFDM manual should describe any changes to the process for identified events where an air safety report (ASR) has been submitted. In the case of a reportable occurrence or accident, any data retained by the programme should not be deidentified or removed from the system prior to the investigation or confirmation that it is not required. This will allow safety investigators access to all relevant information.

## 8.3 Review and Playback

Many systems have the ability to review and visualise data to support crew debriefing following an event.

As with accident investigation, animation has both benefits and drawbacks. Animation can provide a very powerful depiction of a flight in a way that raw data and graphs do not and can utilise external aircraft views or instrument panels to assist. Some pilots find this very helpful in visualising and recalling the event, and a useful supplement to graphs and metrics.

However, any animation is entirely reliant on the recorded data. This means that any bad data, sensor failures, data glitches etc. will be carried through to the visualisation and could be misleading in a way that graphs may not be. In addition, visualisations sometimes have limitations on accuracy and are often unable to depict the exact conditions, such as weather and other traffic, which can lead to inaccurate interpretations and conclusions. Finally, the power of visualisations can make it difficult to recall the event as it happened (particularly if it differs from the visualisation) or to imagine different scenarios to that depicted. For this reason, it is desirable to discuss the event with the crew before they see any visualisation.

Therefore, visualisation should be used as a tool to support review, but being mindful of the limitations and potential pitfalls. The EOFDM Forum[12] notes that:

*"Any kind of flight-data-based visualisation (plots, animations, etc.) generated to provide feedback to the flight crews should not be made available without pre-validation and technical support to interpret the visualisation, and assistance from an honest broker / gatekeeper with operational experience. Indeed, systematically providing data without support and context is likely to be counter-productive."*

Regardless of the review system being used, operators should have a process to allow the effective review and debrief of crews at all base locations, including permanent remote bases.

## 8.4 Serious / Repeat Events

In the unusual event of repetitive, deliberate violations of SOPs and limitations and/or unprofessional, reckless behaviour (cynical abuse), the operator should have a procedure detailed in the confidentiality agreement that will enable escalation and, in certain clearly-defined circumstances, disciplinary or administrative action to be taken. Any assessment of this type of activity should be led by the safety manager, supported by the HFDM team.

However, any action being considered should be viewed in the context of the Just Culture of the organization.

Where action is taken against flight crew, the reasons for the decision and the data justifying the action should be securely archived to allow the decision to be re-assessed or reviewed at a later date.

Such behaviour by flight crew and the need for response by the operator should be extremely rare. If it is not, then it may be worth the operator examining their own safety culture.

## 8.5 Data Storage, Retention and Back-up

HFDM data should ideally be stored for as long as is practicable and routine backups completed or the data mirrored to allow recovery in the case of a system failure. However, this may be subject to any union agreements about data retention. Results data may be able to be held for longer than raw data.

Keeping data accessible can be extremely useful for an operator to be able to conduct new analysis on older data. However, the operator should consider fully de-identifying data after a certain period. This process should be weighed against the limitations that are introduced by permanently removing data such as specific date and time or location.

Where an aircraft is leased to a different operation, the ownership of, and access to, the HFDM data generated while on lease should be made clear as part of the lease agreement.

# Section 9 Programme Audits

# Section 9
# Programme Audits

The HFDM programme should aspire to continual improvement. Any audit process, whether internal or external, should conform fully to the confidentiality agreement.

> IOGP Report 690[9] specifies that:
>
> *"A Quality Assurance (QA) system… is developed, documented, and implemented.*
>
> *The QA system details a programme of risk-based audits using trained personnel, independent from the activities to be audited.*
>
> *The audit programme covers internal processes, specialised activities, such as HFDM and HUMS, as well any externally contracted operations or activities."*

## 9.1 Internal Audits and Review

The HFDM programme should be subject to the operator's internal audit QA process. This process should employ means that do not risk the independence and security of the HFDM programme, especially in smaller operations where some positions may be combined.

To support continued improvement, the HFDM Review Group should meet at regular intervals (quarterly recommended) to review HFDM results and make recommendations for suggested changes to operational procedures or training syllabuses. A procedure should also be put in place to track the implementation of those recommendations and a monitoring process to determine their effectiveness. An overview of these actions, together with the Key Performance Indicators, should be included as an agenda item in the operator's periodic Senior Management reviews, alongside the Safety and Quality Assurance (SQA) summaries.

Event logic and thresholds should be kept under review to ensure they adapt as SOPs change, experience grows and measurements evolve. In this way, the learning from previous data can improve the system for the future.

The focus of an internal audit should never be an individual flight, but rather the overall performance of the HFDM programme, including governance and oversight.

## 9.2 External Audits

It is often a contractual requirement to allow Oil and Gas customers to audit parts of the HFDM programme to assure that the process is working and helping to improve safety. Such an audit should not give right of access to the data, especially that which is identifiable to an individual. In all situations, the confidentiality agreement must be complied with.

The fundamental question an auditor should aim to answer of an HFDM programme is:

*"Is the HFDM programme effective?"*

When auditing, it may be useful to separate the HFDM programme into a number of different areas. For example, for the overall programme the following groupings may be useful:

- Programme in General
- People
- Training
- Agreements / Policies
- Links to the SMS and Culture
- Equipment / Systems
- Functionality / Maintenance

Similarly, for the software and data, the following groupings may be useful:

- Events
- Accuracy / data availability
- Operational Functionality
- Severity / Risk
- Trending / Analysis
- Feedback / Acting on Results

However, all questions should be geared towards answering the overriding question of effectiveness. For example, when considering, say, event thresholds it would be entirely appropriate for an auditor to ask questions such as:

- How are your thresholds derived?
- How do you satisfy yourself they're effective?
- What process do you use for reviewing and updating the thresholds?

However, it would not be appropriate to ask to see the precise thresholds being used and compare them with another operation.

# Section 10 Other Topics

# Section 10
# Other Topics

## 10.1 Use of HFDM Data in EBT/ATQP

An evidence-based training (EBT) programme adopts a competency-based training assessment (CBTA) approach applied to an analysis of appropriately prioritised operational risks to effectively manage pilot training, and prioritises *"the development and assessment of defined competencies"* to *"allow a pilot to manage previously unseen potentially dangerous situations in flight"*[41]. Alternative Training Qualification Programmes (ATQPs) have existed in the fixed-wing community for more than a decade, but have not generally been made accessible to helicopter operations. EBT programmes have been developed over the last decade[42] and are set to replace ATQP, particularly in Europe where a regulatory framework has been developed by EASA. ATQP and EBT programmes make significant use of FDM data.

Work to develop equivalent training systems in offshore helicopter operations is well underway[43,44] but has found significant differences in content and format of operators' HFDM systems and SOPs to be a hindrance to supplying data. Data-sharing forums may provide the answer to this difficulty (see *Section 10.3*) and so operators may wish to make sure their confidentiality agreement can accommodate this type of data-sharing.

## 10.2 Statistics

As described in *Section 7.6*, much of the true power of FDM comes not from analysing individual flights for events, but from analysing very large numbers of flights to look for trends in the operation. Statistics can help operators achieve this and can also help them to overcome biases. The type of overarching questions an operator might look to answer using statistical analysis include:

- Has the operation changed?
- Is the pattern perceived in the data, real?
- How unlikely was the number of events seen last month?

There are numerous accessible, comprehensive statistics books available, see[45-47] for example. *CAP 739*[2] offers some guidance on statistics and Working Group C of the EOFDM Forum is currently drafting an *FDM Analysis and Techniques*[48] guide that will offer support.

A better understanding of statistics can greatly enhance the value an operator can derive from their HFDM programme.

## 10.3 Data-sharing Forums

One question that arises, even in mature HFDM programmes, is that of comparison with other operators. Although each operation has its own SOPs and method of operating, it can still be useful to know whether others are operating in a very different way, and if so, why? This is where data-sharing forums can help.

By sharing data, operators can anonymously compare their operation to that of others, to look for general differences. An additional benefit for the industry from operator participation is the ability to analyse large-scale data sets to look for common problems that go beyond the individual operator (in the same way that HFDM looks for trends in the operator's dataset beyond the individual flight).

Through their HFDM Working Group, HeliOffshore has taken large steps towards the industry-wide sharing of HFDM data. The HeliOffshore programme gathers data into a common, anonymised data format which can then be interrogated for trends across operators.

Please email info@helioffshore.org for more information.

The FAA is expanding ASIAS to include rotorcraft and EASA has expressed interest in a rotorcraft path in their Data4Safety programme. HeliOffshore is linked with both programmes to ensure the best outcomes for the industry.

# Section 11 Summary

# Section 11
# Summary

HFDM is a unique tool for operators – it offers automated collection of objective data to allow them to monitor operations and proactively identify risks to the operation.

In the past, some programmes have focussed almost exclusively on the 'compliance' of individual flights. While there is a role for this type of monitoring, the true value of HFDM lies in the analysis of larger datasets to identify issues such as organizational drift, company training needs and external factors.

However, the programme needs the support of the workforce and so the anonymity of the programme and the link to the organization's Just Culture is absolutely vital. Without employee trust in the system, it is doomed to failure. Similarly, a single data breach or inappropriate action can destroy years of hard-won trust.

This Recommended Practice has aimed to give guidance on the best way to operate a successful HFDM programme. However, HFDM should aim to continually evolve and progress and this document will do the same. By continually pushing the boundaries of their programme, operators can ensure they are deriving maximum value from HFDM.

# Section 12 Definitions / Glossary

# Section 12
# Definitions / Glossary

| | |
|---|---|
| **AC** | An Advisory Circular (AC) is the FAA's means of providing non-regulatory guidance to the public. |
| **alert** | An attention getter activated in an FDM software application when the value of a parameter exceeds a predetermined threshold, sometimes also known as an 'event'. |
| **analysis software** | A software application program designed to: transform airborne-recorded data into a usable form for analysis; process and scan selected flight data parameters; compare recorded or calculated values to predetermined norms using event algorithms; and generate reports for review or trending when they are detected. |
| **ASIAS** | Aviation Safety Information Analysis and Sharing Program, an FAA data-sharing initiative. |
| **ATC** | Air Traffic Control. |
| **ATQP** | Alternative Training Qualification Programme. |
| **CVFDR** | Combined Voice and Flight Data Recorder. |
| **data** | Flight parameters recorded by a device mounted in an aircraft. |
| **deidentified data** | Flight data which does not contain the identity of the flight crew or any identifying elements that could be used to associate them with a particular flight. |
| **DFDR** | Digital Flight Data Recorder. |
| **EASA** | European Union Aviation Safety Agency. |
| **event** | An occurrence or condition in which predetermined values of aircraft parameters are measured. Events represent the conditions to be tracked and monitored during various phases of flight. |
| **event set** | The full collection of events used by an operator. |
| **exceedance** | When the value of a parameter goes beyond a predetermined level (threshold). |
| **FAA** | Federal Aviation Administration. |
| **FDAP** | Flight Data Analysis Programme. |
| **FDM** | Flight Data Monitoring. |
| **FDR** | Flight Data Recorder. |
| **flash card** | Small, mobile storage unit. |
| **FOQA** | Flight Operations Quality Assurance. |
| **gatekeeper** | The gatekeeper is the individual(s) who can link HFDM data to an individual flight or crewmember. |
| **ground station** | A device for collecting the flight data downloaded from an aircraft either manually from flash cards or wirelessly over a network and subsequently making that data available to the FDM analysis software. |
| **HFDM** | Helicopter Flight Data Monitoring. A systematic method of accessing, analyzing and acting upon information obtained from flight data to identify and address operational risks before they can lead to incidents and accidents. |
| **HFDM Review Group** | A group responsible for reviewing and analyzing flight and event data and identifying, recommending, and monitoring corrective actions. |
| **HOMP** | Helicopter Operations Monitoring Programme. |
| **HUMS** | Health and Usage Monitoring System. |
| **ICAO** | International Civil Aviation Organization. |
| **IHST/IHSF** | International Helicopter Safety Team/International Helicopter Safety Foundation. |
| **Just Culture** | A culture in which personnel are encouraged to and feel comfortable disclosing errors, including their own, while maintaining professional accountability. A just culture is not, however, tolerant of reckless behaviour or intentional non-compliance with established rules or procedures. |
| **KPI** | Key Performance Indicator. |
| **LAMP** | Line Activity Monitoring Programme. |
| **MCTOM** | Maximum Certified Take-Off Mass. |
| **MOPSC** | Maximum Operational Passenger Seating Configuration. |
| **OEM** | Original Equipment Manufacturer. |
| **parameter** | A measurable variable that supply information about the status of an aircraft system or subsystem, position, or operating environment. |
| **PCMCIA Card** | Personal Computer Memory Card International Association – a type of flash memory card. |

| | |
|---|---|
| **phase of flight** | The flight activity being undertake in any segment of a flight (e.g. cruise, approach etc.). |
| **QAR** | Quick Access Recorder. A recording unit on board the aircraft that stores flight-recorded data. These units are designed to provide quick and easy access to a removable medium, such as an optical disk or PCMCIA card, on which flight information is recorded. |
| **RFM** | Rotorcraft Flight Manual. |
| **event severity** | The parameter limits that classify the degree of deviation from the established norm into two or more event severity categories. |
| **SMS** | Safety Management System. |
| **SOP** | Standard Operating Procedure. |
| **SSQAR** | Solid State Quick Access Recorder. |
| **threshold** | That value of a parameter which when exceeded will generate an event. |
| **TRE** | Type Rating Examiner. |
| **TRI** | Type Rating Instructor. |
| **validation (event)** | The process by which events are checked to ensure that they are genuine and valid and not generated due to a software or system error. |
| **$V_{NO}$** | Normal maximum operating speed (Velocity Normal). |
| **WiFi** | A wireless connection between two computers or devices. |

# Section 13 Appendices

# Section 13
# Appendices

## 13.1 Appendix 1 – Requirements to Fit an FDR

### 13.1.1 EU Rules for Air Operations

Part-CAT CAT.IDE.H.190[49] addresses Flight Data Recorders, and states that:

*"(a) The following helicopters shall be equipped with an FDR that uses a digital method of recording and storing data and for which a method of readily retrieving that data from the storage medium is available:*
*(1) helicopters with an MCTOM of more than 3175 kg and first issued with an individual CofA on or after 1 August 1999;*
*(2) helicopters with an MCTOM of more than 7000 kg, or an MOPSC of more than nine, and first issued with an individual CofA on or after 1 January 1989 but before 1 August 1999."*

### 13.1.2 FAA

In the US, 14 CFR §135.152 - Flight data recorders[37] covers the requirement to fit a Flight Data Recorder, stating:

*"(a) Except as provided in paragraph (k) of this section, no person may operate under this part a multi-engine, turbine-engine powered … rotorcraft having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that was either brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium…*

*(b) After October 11, 1991, no person may operate a multiengine, turbine-powered rotorcraft having a passenger seating configuration of 20 or more seats unless it is equipped with one or more approved flight recorders that utilize a digital method of recording and storing data, and a method of readily retrieving that data from the storage medium…"*

Paragraph (k) provides some exemptions:

*"(k) For aircraft manufactured before August 18, 1997, the following aircraft types need not comply with this section: Bell 212, Bell 214ST, Bell 412, Bell 412SP, Boeing Chinook (BV-234), Boeing/Kawasaki Vertol 107 (BV/KV-107-II), deHavilland DHC-6, Eurocopter Puma 330J, Sikorsky 58, Sikorsky 61N, Sikorsky 76A."*

Single engine aircraft are not required to carry an FDR. FAA AC 20-141B[47] provides more guidance.

### 13.1.3 Transport Canada

Canadian Aviation Regulations[51] require that flight data recorders are fitted to multi-engined, turbine-powered aircraft

*"605.33 (1)*
*(a) …in respect of which a type certificate has been issued authorizing the transport of 30 or fewer passengers, configured for 10 or more passenger seats and manufactured after October 11, 1991;*

*(c) an aircraft in respect of which a type certificate has been issued authorizing the transport of more than 30 passengers"*

## 13.2 Appendix 2 - HFDM Vendors and Training

The list below is for convenience – no endorsement or recommendation is implied.

### 13.2.1 HFDM Software / Service Providers

| Vendor | Product | Website | Training? |
|---|---|---|---|
| Aerobytes | Aerobytes | https://www.aerobytes.co.uk | Y |
| Appareo | Vision 1000/ALERTS | https://www.appareo.com/aviation/flight-data-monitoring/ | - |
| CAPACG | FlyteAnalytics | https://capacg.com | - |
| Flight Data People | FDM360 | https://www.flightdatapeople.com | Y |
| Flight Data Services / L3Harris | Flight Data Connect | https://www.flightdataservices.com | Y |
| Flight Data Vision | PGS Vision / Analysis / Replay | https://flightdatavision.com/ | - |
| GE Digital | EMS | https://www.geaviation.com/digital/business-optimization/event-measurement-system | Y |
| Helinalysis | HFDM | https://www.helinalysis.com | - |
| Outerlink Global Solutions | IRIS / FASTARS | http://www.outerlink.com | Y |
| Plane Sciences | Insight\|FDM | https://www.planesciences.com | Y |
| SAFRAN | Cassiopée / AGS | https://www.cassiopee.aero | Y |
| Skytrac | HFDM | https://www.skytrac.ca/our-products/flight-data-monitoring/ | Y |
| Truth Data | HFDM | https://www.truthdata.net | - |

### 13.2.2 General FDM Training Courses

| Provider | Website |
|---|---|
| CAA International | https://caainternational.com/course/oversight-flight-data-analysis-programmes/ |
| Cranfield University | https://www.cranfield.ac.uk/courses/short/transport-systems/flight-data-monitoring-fdm-foqa |
| JAA TO | https://jaato.com/courses/212/flight-data-monitoringflight-data-analysis-programme-intro/ |
| Sofema Aviation Services | https://sofemaonline.com/blog/entry/easa-flight-data-monitoring-fdm-data-analysis-methodology |
| Southern California Safety Institute | https://scsi-inc.com/index.cfm?pagetitle=FDA |

## 13.3 Appendix 3 – Parameters in AMC1.1 to CAT.IDE.H.190

AMC 1.1 to CAT.IDE.H.190[36] defines the operational performance requirements for helicopters having an MCTOM of more than 3,175 kg and first issued with an individual CofA on or after 1 January 2016 and before 1 January 2023. The AMC notes that:

*"The FDR should, with reference to a timescale, record:*

*(1) the parameters listed in Table 1 below;*
*(2) the additional parameters listed in Table 2 overleaf, when the information data source for the parameter is used by helicopter systems or is available on the instrument panel for use by the flight crew to operate the helicopter; and*
*(3) any dedicated parameters related to novel or unique design or operational characteristics of the helicopter as determined by the Agency."*

**Table 1 – FDR – all helicopters (taken from AMC1.1 to CAT.IDE.H.190[52])**

| No.* | Parameter |
|---|---|
| 1 | Time or relative time count |
| 2 | Pressure altitude |
| 3 | Indicated airspeed or calibrated airspeed |
| 4 | Heading |
| 5 | Normal acceleration |
| 6 | Pitch attitude |
| 7 | Roll attitude |
| 8 | Manual radio transmission keying CVR/FDR synchronisation reference |
| **9** | **Power on each engine** |
| 9a | Free power turbine speed (NF) |
| 9b | Engine torque |
| 9c | Engine gas generator speed (NG) |
| 9d | Flight crew compartment power control position |
| 9e | Other parameters to enable engine power to be determined |
| **10** | **Rotor:** |
| 10a | Main rotor speed |
| 10b | Rotor brake (if installed) |
| **11** | **Primary flight controls – Pilot input and/or control output position (if applicable)** |
| 11a | Collective pitch |
| 11b | Longitudinal cyclic pitch |
| 11c | Lateral cyclic pitch |
| 11d | Tail rotor pedal |
| 11e | Controllable stabiliser (if applicable) |
| 11f | Hydraulic selection |
| 12 | Hydraulics low pressure (each system should be recorded) |
| 13 | Outside air temperature |
| 18 | Yaw rate or yaw acceleration |
| 20 | Longitudinal acceleration (body axis) |
| 21 | Lateral acceleration |
| 25 | Marker beacon passage |
| 26 | Warnings – a discrete should be recorded for the master warning, gearbox low oil pressure and stability augmentation system failure. Other 'red' warnings should be recorded where the warning condition cannot be determined from other parameters or from the cockpit voice recorder. |
| 27 | Each navigation receiver frequency selection |
| 37 | Engine control modes |

* The number in the left hand column reflects the serial numbers depicted in EUROCAE Document ED-112

**Table 2 - Helicopters for which the data source for the parameter is either used by helicopter systems or is available on the instrument panel for use by the flight crew to operate the helicopter (taken from AMC1.1 to CAT.IDE.H.190[52])**

| **No.*** | **Parameter** |
|---|---|
| 14 | AFCS mode and engagement status |
| 15 | Stability augmentation system engagement (each system should be recorded) |
| 16 | Main gear box oil pressure |
| **17** | **Gear box oil temperature** |
| 17a | Main gear box oil temperature |
| 17b | Intermediate gear box oil temperature |
| 17c | Tail rotor gear box oil temperature |
| 19 | Indicated sling load force (if signals readily available) |
| 22 | Radio altitude |
| **23** | **Vertical deviation – the approach aid in use should be recorded.** |
| 23a | ILS glide path |
| 23b | MLS elevation |
| 23c | GNSS approach path |
| **24** | **Horizontal deviation – the approach aid in use should be recorded.** |
| 24a | ILS localiser |
| 24b | MLS azimuth |
| 24c | GNSS approach path |
| 28 | DME 1 & 2 distances |
| **29** | **Navigation data** |
| 29a | Drift angle |
| 29b | Wind speed |
| 29c | Wind direction |
| 29d | Latitude |
| 29e | Longitude |
| 29f | Ground speed |
| 30 | Landing gear or gear selector position |
| 31 | Engine exhaust gas temperature (T4) |
| 32 | Turbine inlet temperature (TIT/ITT) |
| 33 | Fuel contents |
| 34 | Altitude rate (vertical speed) – only necessary when available from cockpit instruments |
| 35 | Ice detection |
| **36** | **Helicopter health and usage monitor system (HUMS)** |
| 36a | Engine data |
| 36b | Chip detector |
| 36c | Track timing |
| 36d | Exceedance discretes |
| 36e | Broadband average engine vibration |
| **38** | **Selected barometric setting – to be recorded for helicopters where the parameter is displayed electronically** |
| 38a | Pilot |
| 38b | Co-pilot |
| 39 | Selected altitude (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 40 | Selected speed (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 41 | Selected Mach (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 42 | Selected vertical speed (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 43 | Selected heading (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 44 | Selected flight path (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 45 | Selected decision height (all pilot selectable modes of operation) – to be recorded for the helicopters where the parameter is displayed electronically |
| 46 | EFIS display format |
| 47 | Multi-function/engine/alerts display format |
| 48 | Event marker |

## 13.4 Appendix 4 - Generic Event List

The list below was given in the Global HFDM *Industry Best Practice*[25] which gives more details and is included in the guidance material to *SPA.HOFO.145*[52].

The specific parameters required to create these events are not listed, but need to be determined by aircraft type and equipment fit. Further guidance is given in the Global HFDM *Industry Best Practice*[25] or by reference to specific OEMs. Not all aircraft types will be capable of monitoring all events.

The list is not exhaustive and should be tailored for specific operations. The misspelling of discrete as "discreet" was introduced in the original document.

**Table 1 – Examples of FDM events**

| **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. |
| 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 |
| Event title/description | Parameters required | Comments |
| 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 take-off | 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. |
| **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 (OEI) discreet, Palt, OAT | 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 low-level 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 low-level flight. |
| **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. |
| 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 |
| Event title/description | Parameters required | Comments |
| 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. |
| Manoeuvre 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. See United Kingdom Civil Aviation Authority (UK CAA) Paper 2002/02. |
| 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. |
| Torque split | No 1 engine Tq, No 2 engine Tq | To identify engine-related issues. |
| Pilot event | Pilot event discreet | To identify when flight crews have depressed the pilot event button. |
| 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. |
| 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 inadvertent lift-off without autopilot engaged. |
| Autopilot engaged on ground (postflight or preflight) | 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 non-departure) | 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 non-departure) | 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'. |
| 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. |

## 13.5 Appendix 5 - HeliOffshore Safety Event Approach

**Background**

The inherent flexibility of helicopters means that defining safety events in Helicopter Flight Data Monitoring (HFDM) is more complex than in fixed wing operations where, for example, narrow optimum airspeed margins can easily be defined.

Despite this complexity, both the use and the potential of HFDM has increased significantly in the last 10 years due, in part, to increases in data availability and data handling capabilities.

However, in some cases, this evolution has not always resulted in better monitoring of flight safety events; sometimes FDM events have been added without a clear safety aim. This has led some operators to adopt a 'back to basics' approach and revisit their event sets to remove extraneous or superfluous events.

Similarly, HFDM is often used to monitor parameters for efficiency or maintenance purposes. This is an entirely appropriate use of HFDM, but it should not be confused with the core safety goal.

**Aims**

Given the situation described above, it seems timely to revisit the core safety risks faced by a typical commercial passenger transport operation.

This can provide multiple benefits, including:

- provide a starting point for operators planning to establish, or with a newly established, FDM system;
- provide experienced operators with a cross-check for their current event sets;
- share experience of HFDM parameters and events between operators;
- provide auditors with a core list of safety risks to be mitigated; and
- provide HFDM software vendors with a template for embedded events.

Some may view this reduction in absolute number of events as a retrograde step. However, by focussing on the specific safety risks within the operation, and relating HFDM events back to those risks, operators can ensure that their system adopts a focussed, 'performance-based' approach rather than monitoring of a more diffuse set of unrelated events.

Improved data handling has also made it possible to examine much larger datasets. For example, it is now entirely possible to examine parameters and measurements from all flights in a database, rather than simply examining those flights which trigger an event. This type of 'distribution-based' approach, when coupled with core safety event monitoring, has the potential to be more powerful than event monitoring alone as it gives visibility of a complete operation rather than just single 'outlier' flights.

**Trigger Levels**

It is not the aim of this document to prescribe trigger levels for each of the safety events described below as each operation may be different. However, where limits are given by the OEM in documents such as the Rotorcraft Flight Manual (RFM), these are documented below.

In some phases of flight (e.g. approach or take-off) it may be beneficial to vary trigger limits based on the aircraft location within the flight phase; inspecting for events in these phases is not usually as simple as setting a single, acceptable threshold for each parameter and inspecting that parameter across the whole phase.

**Safety Events**

The following event sets were defined by the HeliOffshore HFDM Working Group focussing on the S-92.

### Safety Event 1: Maintaining Ground Stability

Monitoring aircraft stability during ground operations in order to minimize one's exposure to incidents such as rollover, airframe damage, and potential "contact" with obstacles (aircraft, ground support vehicles, pedestrians) associated with high taxi-speeds, excessive taxi-turn rates, etc. can provide valuable information enabling operators to gain assurances around standard operating procedures.

| Conditions to monitor | Notes |
|---|---|
| Maximum ground taxi speed | |
| Excessive power | |
| **Additional conditions to monitor** | **Notes** |
| Max pedal input in taxi | |
| Max yaw rate during taxi | |
| Max lateral acceleration during taxi | |
| Max cyclic movement during taxi | |

### Safety Event 2: Stabilised take-off (flight path and configuration) up to 'end of take-off' e.g. deck + 500ft

| Conditions to monitor | Notes |
|---|---|
| Power margin on lift to hover | |
| Pitch on departure (high and low) | |
| Positive rate of climb (Vy) | |
| Pitch and roll throughout | |
| Heading change | |
| Gear position | |
| Flight director configuration | |
| Airspeed / groundspeed (Vtoss) | |
| **Additional conditions to monitor** | **Notes** |
| Float switch position | Not available in HUMS |

### Safety Event 3: Stabilised approach to rig (from 500 ft above deck to committed or G/A)

| Conditions to monitor | Notes |
|---|---|
| Vertical speed | |
| Airspeed (high and low) | |
| Groundspeed (too high) | |
| Pitch and roll throughout | |
| Heading change | |
| Gear position | |
| Tailwind monitoring | |
| Go around / missed approach | |
| Vortex Ring / Settling With Power / Mode 7 | |
| Flight director configuration | |
| **Additional conditions to monitor** | **Notes** |
| Float switch position | Not available in HUMS |

### Safety Event 4: Landing

| Conditions to monitor | Notes |
|---|---|
| Vertical acceleration | |
| Outside Air Temperature (for hot gas) | |

### Safety Event 5: In flight, all Phases

| Conditions to monitor | Notes |
|---|---|
| Torque split | |
| Torque IAS>100kts (RFM) | |
| High IAS Low Alt | |
| Low IAS High alt | |
| Low ALT, no landing | |
| Vno exceedance | |
| TQ exceedance RFM | |
| Press alt RFM | |
| Fuel quantity | |
| TCAS RA | Unavailable to some / all? |
| EGPWS / HTAWS | |
| Autorotation detection | |
| Pitch / Roll | |
| Pitch rate / roll rate / yaw rate | |
| Nr | Overspeed and underspeed |
| AP engaged | |

# Section 14 References

# Section 14
# References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You can find out more about HeliOffshore, our safety plan, and the workstreams at **www.helioffshore.org**

This guidance will be updated regularly. If you have comments or suggested amendments, please email: **info@helioffshore.org**

HeliOffshore

*Safety Through Collaboration*