



# HELICOPTER FLIGHT DATA MONITORING

*INDUSTRY BEST PRACTICE*



01 April 2012

[www.HFDM.org](http://www.HFDM.org)



## Acknowledgements

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## Document Control Sheet

Version	Date	Change
1.0	September 2011	Original
1.1	April 2012	Para 7.1.1 Reference to 'memory buffering' following the recommendation by the UK AAIB following the G-REDL accident.



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## **1 ABOUT THE GLOBAL HFDM STEERING GROUP**

### **1.1 Vision**

Routine and effective utilisation of Helicopter Flight Data Monitoring (HFDM) in a just culture environment across the global helicopter industry.

### **1.2 Mission**

Improve helicopter safety through provision of focus and leadership on issues concerning the manufacture, provision, support and operation of HFDM systems

### **1.3 Goals**

Co-ordinate users requirements for HFDM systems and support and advise aircraft & equipment manufacturers in meeting those requirements.

- Provide a source of expertise, information and advice for users wishing to adopt HFDM systems.
- Development and communication of industry best practice on HFDM matters.

### **1.4 Who We Are**

The Global HFDM Steering Group is a dedicated group of professionals in the rotor-wing aviation sector with expertise in Flight Data Monitoring. The Group is made up of representatives from large and small helicopter operators, helicopter manufacturers, FDM service providers, national civil aviation authorities and safety management system specialists, and is closely aligned with the International Helicopter Safety Team (IHST). Visit [www.HFDM.org](http://www.HFDM.org) for a list of Who's Who.

## **2 INTRODUCTION**

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 entities desiring to implement or improve their Flight Data Monitoring (FDM) programs.

## **3 DOCUMENT ORGANIZATION**

In order to provide content in an orderly fashion, best practice information is provided under each specific component or element of a typical FDM program in the order generally recognized as necessary during program development.

## **4 REFERENCES**

- CAP 739 (UKCAA Flight Data Monitoring – A Guide to Good Practice)
- IHST FDM Toolkit

## **5 DEFINITIONS**

**BEST PRACTICE** - a technique or methodology that, through experience and research, has proven to most effectively lead to a desired result. A commitment to using the best practices in any field is a commitment to using all the knowledge and technology at one's disposal to ensure success. The term is used frequently in the fields of health care, government administration, the education system, project management, hardware and software product development, and elsewhere.



- Alert:..... An attention getter activated in an FDM software application when the value of a parameter exceeds a predetermined threshold, also known as an 'event'.
- ATC ..... Air Traffic Control
- Data ..... Flight parameters recorded by a device mounted in an aircraft.
- De-identified data ..... Flight Data which does not contain the identity of the flight crew.
- De-identifiable data ..... Flight data from which the identity of the flight crew cannot be derived. (including by utilizing other data sources such as flight crew rosters)
- Event ..... An exceedance of a combination of one or more parameters beyond a predetermined threshold.
- Exceedance..... When the value of a parameter goes beyond a predetermined level
- FDM..... Flight Data Monitoring
- FDR ..... Flight Data Recorder
- Flash Card ..... Small, mobile storage unit often used in digital cameras
- FOQA ..... Flight Operations Quality Assurance
- FW ..... Fixed Wing (Airplanes)
- 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
- HOMP ..... Helicopter Operations Monitoring Programme
- ICAO..... International Civil Aviation Organisation
- IHST ..... International Helicopter Safety Team
- KPI ..... Key Performance Indicator
- LAMP ..... Line Activity Monitoring Program
- Legacy Aircraft..... An aircraft which has no digital data busses and can therefore not supply data to an SSQAR or FDR.
- MFOQA..... Military Flight Operations Quality Assurance
- OEM..... Original Equipment Manufacturer
- Parameter ..... An element of aircraft data which is recorded during a flight. (i.e. airspeed or altitude)
- PCMCIA Card ..... Personal Computer Memory Card International Association – a type of flash card.
- QAR ..... Quick Access Recorder
- RW ..... Rotor Wing (Helicopter)
- Safety Report..... A report input into the company's safety reporting system.
- Severity (Alert) ..... A measure of the seriousness of an alert or event.
- 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.
- Validation ..... That process by which events are checked to ensure that they are genuine and valid and not generated due to a software or system error.
- Value ..... A number associated with a parameter. (i.e. if airspeed is 50Kts, the value of airspeed is 50).
- Vno ..... Normal maximum operating speed (Velocity Normal)
- WiFi ..... A wireless connection between two computers or devices

## 6 FDM/SMS RELATIONSHIP

The primary goal of a Safety Management System is to manage risk at a level that is as low as reasonably practicable. An aircraft is at its highest operational risk when it is in motion, yet there is typically minimal information about that activity. In order to capture operational information about aircraft activities, there are two tools available: FDM and safety reporting — of which only FDM is comprehensive and quantifiable.

In the event of in-flight occurrences flight crew are required to submit safety reports. However this system is ineffectual if the crew is unaware the event occurred or unwilling to report an error. In the aviation safety community, it is generally agreed that at least 75% of accidents are due to human error and only a fraction of those errors are captured in a reporting system.

The International Civil Aviation Organisation (ICAO) states in paragraph 6.9.8c in its 2009 Safety Management Manual:

*Service providers shall implement a safety management system (SMS) that:*

- 1) identifies safety hazards;*
- 2) ensures remedial action to maintain safety performance;*
- 3) provides continuous monitoring and regular assessment of the safety performance; and*
- 4) aims at continuous improvement of the overall performance of the SMS*

The primary purpose of the FDM hardware is to record the interaction between the technology (i.e. the aircraft) and the operator (i.e. the flight crew). The purpose of the software is to provide a tool to analyse the interaction either for specific events (reactive), or to assess undesirable trends (proactive and predictive) in the normal operation of the aircraft. These trends, if allowed to continue, could possibly pose a threat to flight safety. In the analysis of the underlying causal factors of the events, information would be obtained to address the organisational factor(s) that influence, guide or prescribe flight operational requirements.

Flight Data Monitoring is the only reliable method of monitoring flight crew compliance with Standard Operating Procedures, it captures all occurrences that take place during flight, even those which the crews are unaware of, and it identifies issues irrespective of a company's reporting culture. When operational changes are made, the results are easily measured for effectiveness, can show tangible improvements in safety, and complete the "Plan, Do, Check, Act" cycle. Where crew memories or perceptions are skewed in comparison to the Flight Data, the flight section can be re-played and, if desirable, added to simulator training scenarios for practical training.

All flights of aircraft with FDM data recording equipment installed will record quantifiable data that can be manipulated to view trends, however it is important to ensure that the human factor is not ignored. Of the five "W's", the recorded flight data will usually define 1) <sup>1</sup>Who; 2) What; 3) Where, and; 4) When, however may not be able to describe the 5) Why. Crew participation is a major component to provide the contextual information that is lacking in the data, to explain the issues surrounding the event, and allow insight into implementing control measures.

There are examples also where other systems identify the hazard, such as an Accident Investigation report, where Flight Data Monitoring can retrieve the detail to determine whether another operation has the same risk. If so, the analysis will allow the adjustment of procedures and training to control the threats and minimize that risk. Knowing that a high risk event such as an Unstable Approach has occurred or occurs frequently is

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<sup>1</sup> Whilst crew identities are not generally recorded within the data, identities can often be determined through aircraft registration, flight details and duty rosters. Documented procedures and agreements are recommended to be put in place to ensure the System is non-punitive in nature and maintains its primary purpose of trend monitoring over time.

only part of the puzzle. A number of threats or combinations of threats may be associated with this event, such as non-compliance to SOPs, training deficiencies, air traffic control, weather and crew fatigue. Once identified, and mitigating measures or controls are put in place, continued monitoring is key to ensure that the changes, a) do not constitute a new threat or hazard, and b) are effective in gaining the desired result. The quantifiable nature of recorded flight data accomplishes this goal.

## 7 FDM PROGRAM COMPONENTS and CORRESPONDING BEST PRACTICES

### 7.1 Hardware & Software

There are a wide range of FDM systems available for both Fixed Wing (FW) and Rotary Wing (RW) aircraft types and the capability of these systems is continually changing. However, in broad terms they can be classified as follows:

- **Flight Data Recorder (FDR) based systems.** This also includes those systems that connect directly to a digital aircraft's data busses, rather than take information from the FDR. Typically this type of system can record a wide range of parameters and is found on medium and heavy, digitally instrumented aircraft types.
- **Stand alone and hybrid systems** that primarily record data from inertial reference instruments and self contained sensors, but also have the capability to take data from a limited number of aircraft systems. Typically this type of system records a limited range of parameters and is primarily used on legacy analogue aircraft and light aircraft types, although with a greater number of digital components on aircraft, a greater number of parameters can be recorded.

#### 7.1.1 In Flight Data Recording.

The types of HFDM Data recording devices used will depend on the types and complexities of the aircraft. In larger and more modern aircraft where FDRs are fitted, the data recorded can be duplicated and additionally recorded on Solid State Quick Access Recorders (SSQARs, also referred to as QARs) which are also often capable of capturing data from additional on board data busses. In smaller and legacy aircraft, a standalone data unit, containing inertial reference instruments may be fitted, these also often have the capability to receive data from additional onboard systems.

The range of data parameters recorded will directly affect the scope and complexity of the monitoring that can be completed and the number and range of events that can be monitored.

The recording system should be capable of storing sufficient data, relevant to the aircraft and system type and the data transfer procedures of the operator, to ensure all data from contiguous flights is processed and analysed. Recording devices should be capable of transferring the data to the media storage device without first holding it in any sort of buffering memory in case of the potential for data loss on sudden or inadvertent power failure. They should be fitted with some easy method of transferring the recorded data to the groundstation.

#### 7.1.2 Data Transfer Capability

It is necessary for the recorded flight data, or if the system has an on-board data analysis capability the analysed data, to be transferred to the analysis computer. Various methods are available for downloading flight data, including utilisation of the flash memory devices found in QARs, wireless transfer (Wi-Fi) and direct cable link connections between recording devices and computers.



Regardless of the means of transfer, the system should have the practical capability for pilots or line maintenance personnel to download the data at the operating base post flight.

The recording media should be capable of storing at least the total data produced by that aircraft system within the planned download period and any additional unforeseen periods which may from time to time be necessary, such as in the case of an unexpected diversion.

Temporary remote base operations should, when operationally possible, be set up with the capability to transmit downloaded data to the analysis computer or direct to a third party for analysis. Where it is not possible to transmit the data over the internet, other methods may be considered.

### **7.1.3 Ground Station**

An FDM ground station will be required at every operating base where data downloads are required to be carried out. Additionally ground stations should have the capability and/or connectivity to transmit the data to the analysis computer or offsite for third party analysis.

### **7.1.4 Data Analysis 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.
- The ability to enable detailed analysis of flight data.
- The ability to provide long term trend analysis of events.

### **7.1.5 Threshold Setting**

Alert detection thresholds set in an FDM system generate events to draw the attention of the data analyst. An event is generated when the value of a parameter exceeds a predetermined level or threshold.

It is generally accepted practice to base alert detection thresholds on the limitations provided in aircraft flight manuals. These should ideally be supplemented by others based on operator specific SOPs, required flight profiles and the principles of good airmanship.

The rationale behind the levels at which alert detection thresholds are set is based on the aims of HFDM programmes to generate events for trending or aggregating over a period of time and to enable crews to be alerted to their own events. Most HFDM analysis software applications have the functionality to enable multiple alert detection threshold levels to be set for each event in the system, such that the degree of exceedance from SOP can be determined by the level of alert detection threshold exceeded. As an example a 'maximum indicated airspeed' event could have multiple alert detection threshold levels based upon the value of the airspeed that was attained during a flight: the low level alert detection threshold may be set a few knots below the acknowledged V<sub>no</sub> for the aircraft, the mid level alert detection threshold could be set at or around the limiting speed, and the high level alert detection threshold can be set at a level above the limitation.

It is important to recognize that the exceedance of some high level alert detection thresholds does not necessarily indicate a high 'risk' event, and further, that high level alert detection thresholds are not equal in 'risk' across all events. For example: If a high level alert detection threshold is breached when roll attitude exceeds 60 degrees of roll, this would constitute a much higher 'risk' if detected at 25 feet AGL than it would if detected at 2500 feet AGL. Thus the high level alert detection threshold does not necessarily relate directly to high 'risk', and therefore risk should be considered separately. Once the alert detection threshold levels are

established they should be documented to enable easy reference in the event that a threshold is inadvertently altered.

It can therefore be summarised in saying that there should ideally be three levels of severity of alert detection for each event, low, medium and high and these should be determined by basing them on the nature of the event, the magnitude of the exceedance and/or the potential consequences. It should be borne in mind that the severity levels in each case will determine the follow up action to be taken as outlined in the flow chart at 7.2 below.

With the alert detection thresholds set in this way the events which will inevitably be generated in the system are then used as the basis for aggregation or trending, and as a trigger for additional actions, such as crew contacts.

A generic event list is provided at Annex A. this is based on the types of systems currently available and may be considered as a reasonably good starting point. Of course not all systems record all the parameters needed for every event and the operator should identify the parameters available to him before going through the list. A more comprehensive table with added functionality is available at [www.hfdm.org/eventlist](http://www.hfdm.org/eventlist)

Some OEM supplied FDM systems (e.g. the joint HUMS/FDM system provided by Sikorsky for the S92 helicopter) have a number of pre-assigned thresholds based on Rotorcraft Flight Manual (RFM) limits. These do not normally cover operation specific flight profiles, SOPs or airmanship principles and so the operator should review and where deemed applicable, they should add these additional events.

### 7.1.6 Review and Playback

The system should have the capability to enable the effective review and debrief of crews at all base locations, including permanent remote bases, using effective visualisation software, including instrument panel graphics and displays of relevant aircraft systems where data is available.

This should also include relevant data depicted on plots, presentation of the data as cockpit instrumentation relevant to the type flown, and showing a graphical depiction of the aircraft and location.

### 7.1.7 Data Storage & Back-up

FDM data should ideally be stored for minimum period of 12 months and routine back-ups completed. If storing data for a longer period, consideration may be given to de-identifying all the stored data after a defined period, to prevent future misuse by third parties.

## 7.2 Organizational Structure

The actual FDM organizational structure and numbers of personnel involved, whether full time or part-time, will depend on the operator's size and the number of aircraft covered by the FDM program. However, it must take into account staff absence, leave and turnover to provide sufficient cover.

The FDM Programme should have an appointed independent manager with responsibility for the timely provision of output from the system sufficient to allow company management the opportunity to make informed decisions about the safety and effectiveness of the operation.

### 7.2.1 FDM System/Program Manager

- Responsible for overall management of the system/program and reporting to a Functional Department Head.



- It should be an individual who is an experienced pilot, who is respected and trusted by the pilot workforce and is not part of the core senior management team. In very small organisations, this may be unavoidable.
- The FDM Program Manager is responsible for the classification of events, the completion of follow up activity and for producing periodic FDM reports for distribution within the organisation regarding fleet wide trending information.

### **7.2.2 Pilot Liaison**

- Experienced and trusted pilot(s) responsible for informing crews of alert detection threshold exceedances, reviewing and explaining the data using playback and analysis software and feeding back pilots responses to the analysis process.

### **7.2.3 Data Analyst(s)**

- Individual(s) competent in the use of the system's data analysis software to validate events, analyse flight data trends, produce periodic FDM reports and newsletters and provide data in a format usable and easily understood for pilot debriefs and crew feedback requests.
- To enable effective validation of events and to allow customisation of the process to an individual operator's mission and requirements, it is recommended that this capability is normally performed in house. However, provided some level of in house analysis capability exists, the primary data analysis could be performed by a third party.

### **7.2.4 FDM Review Group**

The FDM Review Group should ideally be comprised of those members of the operation who have responsibility for operational standards and flight safety. In large or medium sized operations these could be the Chief Pilot, Head of Flight Standards, Flight Safety Officer, Training Captains and others as required. The HFDM Programme Manager should also be present along with any data analysts. In smaller organisations this may only be the owner or managing director/CEO of the Company. The group should have the following responsibilities:

- Periodical review of de-identified FDM data findings.
- Determining and periodically reviewing the alert detection threshold positions.
- Making recommendations for changes to procedures and training to the accountable manager.
- Investigation of significant events discovered by the FDM Programme.
- 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 FDM Programme remains just as opposed to non-punitive.

### **7.2.5 Scale**

The capabilities listed in 7.2.1 – 7.2.4 above may be completed by as few as two part-time individuals in a small operation or by numerous full and part-time personnel in a larger organisation.

The allocation of sufficient resources to complete the assigned roles is crucial to the effectiveness of the system. It is very important that the collected flight data be regularly reviewed ideally on a daily basis and the necessary resources should be made available to do so. The inclusion of these tasks into an individual's job



description will also help to allocate responsibility for the various roles. To enable this, larger organisations should strive to employ full time, dedicated data analysts.

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

In smaller operators, where the FDM 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 de-identified data. In a very small operation the FDM Manager may actually be the owner or Managing Director/CEO of the Company. In such cases confidentiality is very difficult, if not impossible, to achieve but FDM systems can still be very effective and retain the support of the staff, particularly where there is a just culture in the organisation.

### **7.2.6 Personnel Training**

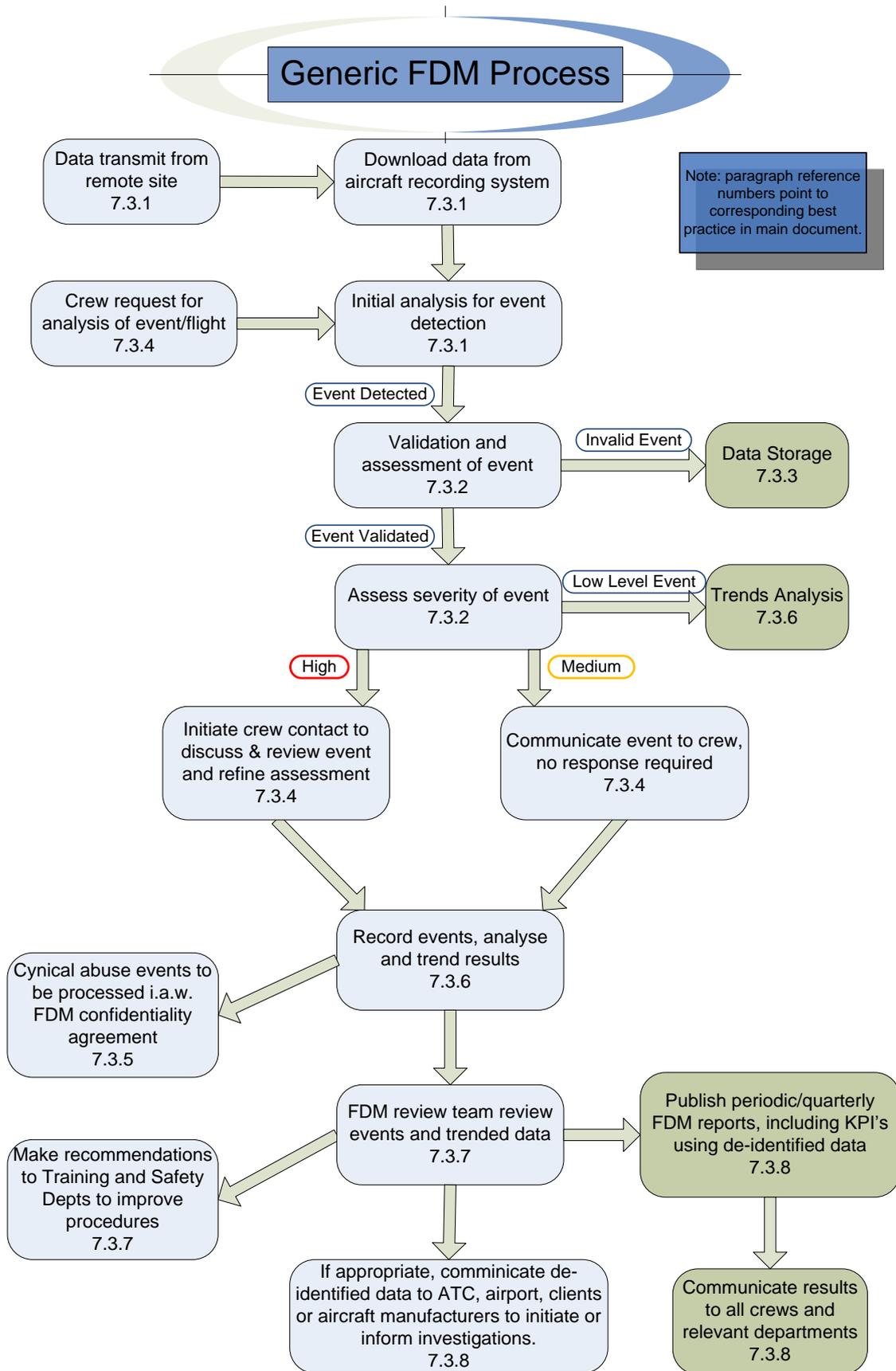
Training should ideally be provided for all FDM posts, appropriate to their level of use. The data analyst needs to have "relevant expert" levels of skill in working the systems, as should the FDM Manager. The pilot liaison positions will require knowledge of the review/playback systems and must be able to interpret data provided by the analyst.

Line pilots, or in some circumstances line maintenance staff, are likely to need only sufficient knowledge to download data. However, all personnel should have a full and clear understanding of what the system is designed to achieve in safety terms. Maintenance staffs need to be able to test and assess the system's serviceability status and carry out associated maintenance.

FDM Programmes are much better received when pilots and staff are briefed on their processes in advance of launching the programme. It is very important to have the support of pilots to ensure that the lessons learnt are understood and accepted. A process of pre-launch communication is an ideal way to get the messages across in advance of any misconceptions about abuse of the flight data are allowed to form.

### **7.3 FDM System Process**

The process shown below is considered best practice and is described in more detail.



### 7.3.1 Collect and Process Flight Data.

- FDM data should be downloaded and subjected to initial analysis to identify events on a daily basis.
- For aircraft operating routinely from temporary remote bases, a means of downloading and transmitting the data on a daily basis, or as often as possible, should be established.
- Successful data download rate from the operators fleet can be a useful Key Performance Indicator (KPI).

### 7.3.2 Validate and Assess Event Data.

Event data should ideally be validated on a daily basis (working days only) to ensure that any events recorded have been generated correctly, this is true for both in house data analysis and third party analysis services, subject to the following exceptions:

- For small operators, who have just one pilot liaison/analyst, the analysis frequency may have to reflect that individuals work schedule. However, where practicable, redundancy should be provided by a second pilot liaison/analyst.
- Small operators should consider using a non pilot staff member, whose availability is greater, to conduct a daily first look at the data to establish whether any events have been recorded. They can then communicate the need for further assessment to the dedicated pilot liaison/analyst. This additional staff member would have to be party to the confidentiality agreement.

The key reasons for requiring daily analysis of FDM data are to ensure that any significant medium and high risk events are highlighted to the flight crews as soon as possible to prevent the risk of re-occurrence, and that other events which require crew feedback can be communicated to pilots within a period where they will be able to recall the flight with clarity and assist in the analysis process. The risk of delaying feedback requests is that pilots may be unable to recall particular flights and hence the benefit of the feedback system is lost.

The analysis of the data may include a process to exclude events generated during maintenance test flights or training flights.

### 7.3.3 Store Data

FDM data can be stored for extended periods of time and a minimum of 12 months is recommended. If storing data for longer periods, consideration may be given to de-identifying the data to prevent future misuse by third parties.

### 7.3.4 Crew Contact

Crew contact is an essential element of an effective FDM system. If the only information received by crews is de-identified trended data in periodic reports, then a significant proportion of the benefit of the system may be lost. Individual feedback enables individual accountability and has been shown to have a significant impact in changing behaviour.

For this reason it is recommended that all "valid" and relevant medium and high FDM events that exceed operating standards should result in a crew contact. This enables crews to be alerted to even minor departures from operating standards and limits and ensures those events do not become normalised by lack of action. The validation process should discount from future trend analysis those events associated, for instance, with training or maintenance check flights.



For those events, which may be assessed as medium risk, this contact can be just an advisory contact by email or other means, to alert the pilot or crew of the event, but does not necessarily require further follow up action.

- This action could be completed by the individual performing the analysis, subject to the confidentiality conditions.
- For events assessed as high risk, a more comprehensive contact should be required, which involves dialogue between the Pilot Liaison function and the crew involved.
- This contact should include a data review in the presence of the flight crew by the pilot liaison on base, the relevant points noted in the data should be discussed and the flight crew given the opportunity to provide an explanation of the reasons behind the indicated data. The aim is for the flight crew to assist in the analysis of the event and potentially learn from the review. In cases of flight crews who repeatedly make significant breaches, the system should allow for debriefs to be escalated to management level for appropriate remedial and/or disciplinary action.
- 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.

Operators should have in place a process for crews to request feedback from a particular flight or event. This will only be for a flight which they have personally been operating and may include a visual playback and debrief from the local FDM specialist.

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

The FDM system can also be used as a debrief tool for programmed training flights, provided this has been previously agreed and documented as a procedure.

### **7.3.5 Cynical Abuse Action**

In the event of repetitive, deliberate violations of SOP's and limitations and/or unprofessional, reckless behaviour (wilful misuse or cynical abuse), the operator should have a procedure detailed in the confidentiality agreement that will enable escalation and in certain defined circumstances, disciplinary or administrative action to be taken.

### **7.3.6 Perform Trend Analysis & Record the Results**

Trend monitoring is another essential element of the FDM system and should be undertaken as a routine part of the process to give advance warning of developing issues in a flight operation.

The aim of trending or aggregating the data is to give the opportunity for management intervention before operating limitations are breached, as well as identifying trends in actual exceedances. When data aggregated over a period of time shows an increasing tendency of crews to operate the aircraft closer to the established operational limitations, action can be taken to adjust procedures and/or practises to reverse the adverse direction of the trends identified. The rationale behind the setting of event detection thresholds supports this process by generating low level events below operational limitations such that these events can be trended to provide warnings before limitations are exceeded. Thus the FDM programme becomes predictive and enables preventative action to be taken in advance of operational exceedances, reducing the risks in the operation.



Following analysis of the FDM data and, when necessary, further investigation and crew contacts, the results should be recorded and stored in a format that enables future access for reference and comparison. For example, specific events occurring regularly at specific airports or locations, or events occurring on a seasonal basis due to weather factors.

Once FDM trend monitoring has been established, Key Performance Indicators can also be used to measure the effectiveness of the FDM system and any follow up actions taken.

A common KPI used by many established FDM operators is “events per flight”, but other Key Performance Indicators can also be used, targeted at specific areas of concern or risk.

### **7.3.7 Periodic Review**

The FDM Review Group should meet at regular intervals (Quarterly recommended) to review FDM results and make recommendations for suggested changes to operational procedures or training syllabi.

- 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 (QA) summaries.

### **7.3.8 Communicate Results**

All communication and transfer of FDM data and information must comply with the operator’s confidentiality agreement.

The FDM Manager should produce regular FDM reports, summarising event activity within the organisation and highlighting trends from the analysis. These reports, which can be in the form of newsletters should be made available and communicated to all crews and relevant departments.

- The information contained in the reports/newsletters must be de-identified so that a wide distribution within the organization can be achieved.
- Typically the reports/newsletter will identify the most commonly occurring events per aircraft type or by location. Individual events can also be highlighted if they provide valuable learning.
- When considered appropriate by the operator, de-identified FDM information can also be communicated to outside organisations such as ATC, airports, customers and aircraft manufacturers, if required to initiate or inform safety investigations of changes of procedures within that organisation.
- For example, the use of FDM data to support a change in local air traffic procedures due to repeated events generated by pilots following ATC instruction, or use of FDM data to inform an investigation into an aircraft incident.

### **7.3.9 Program Audits – Internal/External**

The FDM system should be subject to the operator’s internal audit QA process, using acceptable means that do not risk the independence and security of the FDM program, especially in smaller operations where some positions may be combined.



**FDM Operational Events**

**List**

<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Ground</b>		
<b>OAT High - Operating limits</b>	OAT	To identify when the aircraft is operated at the limits of OAT
<b>Sloping Ground High Pitch Attitude</b>	Pitch Attitude, WOW	To identify when the aircraft is operated at the limits of up slope
<b>Sloping Ground High Roll Attitude</b>	Roll Attitude, WOW	To identify when the aircraft is operated at the limits of cross slope
<b>Rotor Brake on at excessive NR</b>	Rotor Brake discreet, NR	To identify when the rotor brake is applied at too high an Nr
<b>Ground Taxi Speed - max</b>	Groundspeed, WOW	To identify when the aircraft is ground taxied at high speed (Wheeled aircraft only)
<b>Air Taxi Speed - Max</b>	Ground speed, WOW, Radio Altitude (Ralt)	To identify when the aircraft is air taxied at high speed
<b>Excessive power during ground taxi</b>	Total Tq, WOW, Groundspeed	To identify when excessive power is used during ground taxi.
<b>Pedal - max LH &amp; RH taxi</b>	Pedal Position, ground speed or NR, WOW	To identify when the aircraft flight controls (pedals) are used to excess on the ground. Ground speed or NR to exclude control test prior to rotor start.
<b>Excessive yaw rate on Ground in taxi</b>	Yaw rate, WOW or Ralt	To identify when the aircraft is yawed at a high rate when on the ground
<b>Yaw Rate in Hover or on ground</b>	Yaw Rate, WOW, Groundspeed	To identify when the aircraft is yawed at a high rate when in the hover
<b>High Lateral Acceleration (rapid cornering)</b>	Lateral Acceleration, WOW	To identify high levels of lateral G when ground taxiing indicating high cornering speed
<b>High Longitudinal Acceleration (rapid braking)</b>	Longitudinal Acceleration, WOW	To identify high levels of longitudinal G when ground taxiing indicating excessive braking
<b>Cyclic movement limits during taxi (pitch or roll)</b>	Cyclic stick Posn , WOW or Ralt, NR or groundspeed.	To identify excessive movement of rotor disc when running on ground. Ground speed or NR to exclude control test prior to rotor start



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Ground</b>		
<b>Excessive Rate of Movement of Longitudinal &amp; Lateral Cyclic on Ground</b>	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.
<b>Lateral Cyclic - closest to LH &amp; RH Rollover</b>	Lateral Cyclic Position, WOW, Pedal Position, Roll Attitude, Elapsed Time	To detect the risk of an aircraft roll over due to an incorrect combination of tail rotor pedal and lateral cyclic control position when on ground.
<b>Excessive Cyclic Control with Insufficient Collective Pitch on Ground</b>	Collective Pitch, Longitudinal Cyclic Pitch, Lateral cyclic pitch.	To detect incorrect taxi technique likely to cause rotor head damage
<b>Inadvertent Lift off</b>	WOW, ASE disreet	To detect inadvertent lifting into hover.
<b>Flight - Take off &amp; Landing</b>		
<b>Day or night Landing or take off</b>	Latitude, Longitude, Local Time - OR - UTC	To provide day/night relevance to detected events.
<b>Landing or take off specific location</b>	Lat, Long, WOW, Ralt, Total Tq	To give contextual information concerning departures and destinations
<b>Gear extension &amp; retraction - Airspeed limit</b>	IAS, Gear Position	To identify when undercarriage airspeed limitations are breached
<b>Gear extension &amp; retraction - Height limit</b>	Gear Position, Ralt	To identify when undercarriage altitude limitations are breached
<b>Heavy landing</b>	Normal/Vert acceleration, (WOW)	To identify when hard/heavy landings take place
<b>Cabin Heater On (take-off and landing)</b>	Cabin Heater Discreet, WOW,	To identify use of engine bleed air during periods of high power demand
<b>High Groundspeed Prior to TD</b>	Groundspeed, Ralt, WOW, Elapsed Time, Lat, Long	To assist in identification of 'quickstop' approaches



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight -Speed</b>		
<b>Airspeed - Vno speed exceedances</b>	IAS, weight	To identify excessive airspeed in flight
<b>High Airspeed - Low Altitude</b>	IAS, RALT	To identify excessive airspeed in low level flight
<b>Low Airspeed at altitude</b>	IAS, Rad Alt	To identify hover out of ground effect
<b>Airspeed on Departure (&lt;= 300ft)</b>	IAS, WOW, Rad Alt	To identify shallow departure
<b>High Airspeed - Power Off</b>	IAS, Tq1, Tq2 - OR - OEI discreet	To identify power off airspeed limitation exceedance
<b>Downwind Flight Within 60 seconds of Take-Off</b>	IAS, Ground Speed, elapsed time	To detect early downwind turn after take-off.
<b>Downwind Flight Within 60 seconds of Landing</b>	IAS, Ground Speed, elapsed time	To detect late turn to final shortly before landing.
<b>Flight - Height</b>		
<b>Altitude Maximum</b>	Pressure Altitude (PAlt)	To detect flight outside of published flight envelope
<b>Climb Rate - max</b>	Vertical Speed - OR - Palt - OR - Ralt, Elapsed Time	To identify excessive rates of climb. RoC can be determined from an indication or rate of change of Palt or Ralt
<b>High Rate of Descent</b>	Vertical speed	To identify excessive rates of descent
<b>High Rate of Descent (Speed or height limit)</b>	Vertical speed, IAS or RALT or elevation	To identify excessive rates of descent at low level or low speed
<b>Settling with Power (Vortex ring)</b>	Vertical Speed, IAS(Ground Speed), TQ	To detect high power setting with low speed and excessive rate of descent
<b>Minimum Altitude in Autorotation</b>	Nr, Total Tq, Ralt	To detect late recovery from autorotation
<b>Low Cruise (Inertial systems)</b>	Ground Speed, Vertical Speed, Elevation, (Lat & Long)	To detect extended low level flight. Ground speed less accurate with more false alarms. Lat & Long for geographical boundaries.
<b>Low Cruise (Integrated systems)</b>	Ralt, Elapsed Time, Lat, Long, WOW	To detect extended low level flight.



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight - Attitude &amp; controls</b>		
<b>Excessive Pitch (height related - T/O, cruise or landing)</b>	Pitch Attitude, Ralt (Elevation), (Lat, Long)	To identify inappropriate use of excessive pitch attitude during flight. Height limits may be used (i.e. on take-off & landing or <500'), (Lat, Long required for specific location related limits) Elevation less accurate than RALT. Elevation can be used to identify landing phase in specific location.
<b>Excessive Pitch (speed related - T/O, cruise or landing)</b>	Pitch Attitude, IAS (Ground Speed) , (Lat & Long)	To identify inappropriate use of excessive pitch attitude during flight. Speed limits may be used (i.e. on take-off & landing or in cruise), (Lat, Long required for specific location related limits) Ground speed less accurate than IAS.
<b>Excessive Pitch Rate</b>	Pitch Rate, ( Ralt, IAS, WOW, Lat, Long)	To identify inappropriate use of excessive rate of pitch change during flight. Height limits may be used (i.e. on take-off & landing), IAS only for IAS limit, WOW and Lat, Long required for specific location related limits.
<b>Excessive Roll/bank Attitude (Speed or height related)</b>	Roll Attitude (Ralt , IAS/ Ground Speed)	To identify excessive use of roll attitude. Ralt may be used for height limits, IAS/GND Speed may be used for speed limits.
<b>Excessive Roll Rate</b>	Roll Rate, (Ralt, Lat, Long, WOW)	Ralt may be used for height limits; Lat/Long & WOW required for specific location related and air/ground limits.
<b>Excessive Yaw rate</b>	Yaw rate	To detect excessive yaw rates in flight
<b>Excessive Lateral Cyclic Control</b>	Lateral Cyclic Position (WOW)	To detect movement of the lateral cyclic control to extreme left or right positions. WOW required for pre or post T/O



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight - Attitude &amp; controls cont...</b>		
<b>Excessive Longitudinal Cyclic Control</b>	Longitudinal Cyclic Position (WOW)	To detect movement of the longitudinal cyclic control to extreme forward or aft positions. WOW required for pre or post T/O
<b>Excessive Collective Pitch Control</b>	Collective Position (WOW)	To detect exceedances of the Flight Manual collective pitch limit. WOW required for pre or post T/O
<b>Excessive Tail Rotor Control</b>	Pedal Position, WOW	To detect movement of the tail rotor pedals to extreme left and right positions. WOW required for pre or post T/O
<b>Manoeuvre G Loading (+ve &amp; -ve) or turbulence</b>	Lateral, longitudinal and Normal Accelerations (WOW, Ralt)	To identify excessive 'G' loading of rotor disc both positive and negative. WOW required to determine air/ground, Ralt required if height limit required
<b>Pilot Workload/Turbulence</b>	Collective and /or cyclic and/or T/R Pedal position and change rate. (Lat & Long)	To detect high workload and/or turbulence encountered during take-off and landing phases. Lat & Long for specific landing sites. A specific and complicated algorithm for this event is required. See UK CAA Paper 2002/02
<b>Cross Controlling</b>	Roll Rate, Yaw Rate, Pitch Rate, Ground Speed, Accelerations	To detect out of balance flight. Airspeed could be used instead of Ground Speed
<b>Quick Stop</b>	Ground Speed (min and max), Vertical Speed, Pitch	To identify inappropriate flight characteristics. Airspeed could be used instead of Ground Speed



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight - General</b>		
OEI - Air	OEI Discreet, WOW	To detect OEI conditions in flight
Single Engined flight	No1 Eng Torque, No2 Eng Torque	To detect single engined flight
Torque Split	No1 Eng Torque, No2 Eng Torque	To identify engine related issues
Pilot Event	Pilot Event Discreet	To identify when flight crews have depressed the pilot event button
TCAS Traffic Advisory	TCAS TA Discreet	To identify TCAS alerts
Training Comp Active	Training Computer Active Discreet	To identify when aircraft have been on training flights
High/Low rotor speed - Power On	NR, TQ (WOW, IAS, Gnd Sp)	To identify mishandling of NR. WOW, IAS or ground speed to determine airborne
High/low rotor speed - Power Off	NR, TQ (WOW, IAS, Gnd Sp)	To identify mishandling of NR. WOW, IAS or ground speed to determine airborne
Fuel content low	Fuel contents	To identify low fuel alerts
EGPWS alert	EGPWS alerts discreet	To identify when EGPWS alerts have been activated
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 discreets, WOW, 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
<b>Flight - Approach</b>		
Stable Approach Heading Change	Magnetic Heading, Ralt, WOW, Gear Position, Elapsed Time	To identify unstable approaches
Stable Approach Pitch Attitude	Pitch Attitude, Ralt, WOW, Gear Position	To identify unstable approaches
Stable Approach ROD GS	Altitude Rate, Ralt, WOW, Gear Position	To identify unstable approaches
Stable Approach Track Change	Track, Ralt, WOW, Gear Position	To identify unstable approaches
Stable Approach Angle of Bank	Roll Attitude, Ralt, WOW, Gear Position	To identify unstable approaches
Stable Approach - ROD at specified height	Altitude Rate, Ralt, WOW, Gear Position	To identify unstable approaches



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight - Approach</b>		
<b>Stable Approach IAS @ specified height</b>	IAS, Ralt, WOW, Gear Position	To identify unstable approaches
<b>Glideslope Deviation Above or below</b>	Glideslope Deviation	To identify inaccurately flown ILS approaches
<b>Localiser Deviation Left &amp; right</b>	Localiser Deviation	To identify inaccurately flown ILS approaches
<b>Low Turn to Final</b>	Elevation, Ground Speed, Vertical Speed, Heading Change	Airspeed could be used instead of Ground Speed
<b>Premature Turn to Final</b>	Elevation, Ground Speed, Vertical Speed, Heading Change	Airspeed could be used instead of Ground Speed
<b>Stable Approach - Climb</b>	Indicated Airspeed (min and max), Vertical Speed (min and max), Elevation	To identify unstable approaches
<b>Stable Approach - Descent</b>	Indicated Airspeed (min and max), Vertical Speed, Elevation	To identify unstable approaches
<b>Stable Approach - Bank</b>	Indicated Airspeed (min and max), Vertical Speed, Elevation, Roll	To identify unstable approaches
<b>Stable Approach - late turn</b>	Heading change, elevation, ground speed	To identify unstable approaches
<b>Go around</b>	Gear select (Ralt)	To identify missed approaches. Ralt for height limit
<b>Rate of descent on Approach</b>	Altitude Rate, Ralt, Lat, Long, WOW	To identify high rates of descent when at low level on approach. Ralt if below specified height. Lat, Long for specified location
<b>Flight - Autopilot</b>		
<b>Condition of Autopilot in Flight</b>	Autopilot Discreets	To detect flight without autopilot engaged. Per Channel for multi channel autopilots
<b>AP Engaged within 10 Secs after Take-Off</b>	Autopilot Engaged Discreet, Elapsed Time, WOW, Total Tq, Ralt	To identify inadvertent lift off without autopilot engaged
<b>Autopilot Engaged on Ground (post or pre)</b>	Autopilot Engaged Discreet, Elapsed Time, WOW, Total Tq, Ralt	To identify inappropriate use of autopilot when on ground. Elapsed time required to allow for permissible short periods
<b>Excessive Pitch Attitude with AP Engaged on Ground (Offshore)</b>	Pitch Attitude, AP Discreets, WOW, Lat, Long	To identify potential for low main rotor when aircraft pitching on floating helideck



<b>Event Title/Description</b>	<b>Parameters required</b>	<b>Comments</b>
<b>Flight – Autopilot cont...</b>		
<b>Airspeed Hold Engaged - Airspeed (Departure or non departure)</b>	Autopilot Modes Discreets, IAS, (WOW, Total Tq, Ralt)	To detect early engagement of AP higher modes. WOW, Tq & Ralt to determine if flight profile is 'departure'.
<b>Airspeed Hold Engaged - Altitude (Departure or non departure)</b>	Autopilot Modes Discreets, Ralt, (IAS, WOW, Total Tq)	To detect early engagement of AP higher modes. IAS, WOW, Total TQ to determine if flight profile is "departure"
<b>ALT Mode Engaged - Altitude (Departure or non departure)</b>	Autopilot Modes Discreets, Ralt, (WOW, Total Tq, IAS)	To detect early engagement of AP higher modes. WOW, Tq & Ralt to determine if flight profile is 'departure'.
<b>ALT Mode Engaged - Airspeed (Departure or non departure)</b>	Autopilot Modes Discreets, IAS, (WOW, Total Tq, Ralt)	To detect early engagement of AP higher modes. IAS, WOW, Total TQ to determine if flight profile is "departure"
<b>HDG Mode Engaged - Speed</b>	Autopilot Modes Discreets, IAS	To detect engagement of AP higher modes below minimum speed limitations. WOW, Tq & Ralt to determine if flight profile is 'departure'.
<b>V/S Mode Active - Below spec speed</b>	Autopilot Modes Discreets, IAS	To detect engagement of AP higher modes below minimum speed limitations.
<b>VS Mode Engaged - Altitude (Departure or non departure)</b>	Autopilot Modes Discreets, IAS, (WOW, Total Tq, Ralt)	To detect early engagement of AP higher modes. WOW, Tq & Ralt to determine if flight profile is 'departure'.
<b>FD Engaged - Speed</b>	Flight Director Discreets, IAS	To detect engagement of AP higher modes below minimum speed limitations.
<b>FD Coupled Approach or take off - Airspeed</b>	Flight Director Discreets, IAS, WOW	To detect engagement of AP higher modes below minimum speed limitations.
<b>Go Around Mode Engaged - Airspeed</b>	Autopilot Modes Discreets, IAS, WOW, Total Tq, Ralt	To detect engagement of AP higher modes below minimum speed limitations.
<b>Flight without ASE channels engaged</b>	ASE1/2	To detect flight without autopilot engaged. Per Channel for multi channel autopilots



<b>Aircraft System Events List</b>	
<b>Event Title/Description</b>	<b>Parameters required</b>
Cruise Eng #1/ Eng #2	Ng1, IAS, Palt, Elapsed Time
Cruise Torque Total	Tq1, Tq2, IAS, Palt, Elapsed Time
Cruise Torque Eng #1/ Eng #2	Tq1, IAS, Palt, Elapsed Time
Eng #1/ Eng #2 N1 AEO - max transient (1 sec)	Ng1, Ng2, Elapsed Time
Eng #1/ Eng #2 Power Margin	Computed Power Margin Eng#1
Engine Fire Warning - Air	Fire warning Discreet, WOW, Ralt, Total Tq
Engine Oil Temp	Engine Oil Temp
Engine Running Duration ENG #1/ ENG #2	Ng1, Elapsed Time
GPWS: Active - Discreets	GPWS Discreets, Ralt
Ng AEO - max (1 sec) Eng #1/ Eng #2	Ng1, Ng2, Elapsed Time
Ng AEO - max transients	Ng1, Ng2, Elapsed Time
Ng AEO - max continuous (1 sec)	Ng1, Ng2, Elapsed Time
Ng AEO - max take-off (1 sec)	Ng1, Ng2, Elapsed Time, WOW
NG AEO - max transient	Ng1, Ng2, Elapsed Time
Ng OEI - max (1 sec)	Ng1, Ng2, Elapsed Time
Ng OEI - max transients	Ng1, Ng2, Elapsed Time
Ng Split - largest	Ng1, Ng2, Elapsed Time
Ng Split - warning	Diff Ng Discreet
Nr - max (Power Off)	Nr, Total Tq, Elapsed Time
Nr - max transient (Power Off)	Nr, Total Tq, Elapsed Time
Nr - max (On ground)	Nr, WOW
Nr - max with Rotor Brake (On ground)	Nr, WOW, Rotor Brake Discreet
Nr - min (<IAS> Power Off)	Nr, IAS, Total Tq
Nr - min (<IAS>)	Nr, IAS
Nr - min (1sec)	NR, Elapsed Time
Nr - min (Power Off)	Nr, Total Tq
P2 Air Heater On (landing)	P2 heater on/off Discreet, WOW



<b>Aircraft System Events List</b>	
<b>Event Title/Description</b>	<b>Parameters required</b>
Power Assurance - NG #1/NG #2	Power Assurance Discreets
Power Assurance - T4 Eng #1/ T4 Eng #2	Power Assurance Discreets
T4 - max on start	T4#1, T4#2, Elapsed Time
T4 AEO - max take-Off	T4#1, T4#2, Elapsed Time, WOW
T4 Max continuous Eng #1/Eng #2 AEO	Ng1, Ng2, T4#1, T4#2, Elapsed Time
T4 Max transient	Ng1, Ng2, T4#1, T4#2, Elapsed Time
T4 OEI – max continuous	Ng1, Ng2, T4#1, T4#2
T4 OEI - max transient	Ng1, Ng2, T4#1, T4#2, Elapsed Time
T4/5 Margin Eng #1 S76C++	T4/5 Margin Computations
T4/5 Margin Eng #2 S76C++	T4/5 Margin Computations
Torque AEO - max continuous	Tq1, Tq2, Ng1, Ng2, IAS, Elapsed Time
Torque AEO - max take-Off	Tq1, Tq2, Ng1, Ng2, Elapsed Time
Torque AEO - max transient	Tq1, Tq2, Ng1, Ng2, IAS, Elapsed Time
Torque Split - max	Tq1, Tq2
Torque Split duration	Tq1, Tq2, Elapsed Time
FLI Margin AEO MCP	FLI Margin computation

**Note:**

It should be noted that some events suggest use of Airspeed or Radio Altitude and for some stand-alone systems which generate their own internal data, these parameters are not available. In such cases, with careful application, other parameters such as Groundspeed or Elevation (GPS Altitude) may be substituted, but due account should be taken of the differences between these and those suggested in the events listing.