

**CIVIL AVIATION AUTHORITY PAKISTAN**

**Air Navigation Order**  
**No. : 91.0028**  
**Date : 18<sup>th</sup> Sept., 2009**  
**Issue : Two**

**FLIGHT DATA ANALYSIS (FDA) PROGRAMME AND  
FLIGHT DATA MONITORING**

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## FLIGHT DATA ANALYSIS (FDA) PROGRAMME AND FLIGHT DATA MONITORING

### 1. AUTHORITY

- 1.1 This Air Navigation Order (ANO) is issued by the Director General Pakistan Civil Aviation Authority (PCAA) in pursuance of the powers vested under Rule 4 of Civil Aviation Rules (CARs) 1994.
- 1.2 Flight Data Analysis is the ICAO terminology for processes often referred to as Flight Data Monitoring (FDM) and Flight Operations Quality Assurance (FOQA); this includes a number of activities designed to collect and routinely analyze recorded flight in order to improve the safety of flight operations.
- 1.3 This ANO is supplemental to Part XV – Accidents and Incidents of CARs 1994, and ANO 91.0020, ANO 91.0024 and ANO 91.0033.

### 2. PURPOSE

- 2.1 This document is designed to meet the following objectives:
- a) Outline CAA's view on how FDM may be embodied within an Operator's Safety Management System;
  - b) Give guidance on the policy, preparation and implementation of FDM;
  - c) Describe the principles that should underpin a FDM system acceptable to the CAA.

### 3. SCOPE

- 3.1 All Operators operating with aircraft (including wet lease or damp lease) of a maximum certificated take off mass in excess of 27,000 kgs shall establish and maintain a flight data analysis (FDA) programme as a part of its accident prevention and flight safety programme.
- 3.2 All Operators and/or the service providers (as applicable) shall establish, maintain and comply with Flight Data Monitoring and Flight Safety Document System that must correspond to the provisions of this ANO and that are subject to the approval by the DG CAA.
- 3.3 Regularly review and revise the same in consultation with CAA as widespread FDA experience develops.
- 3.4 A flight data analysis programme shall be non-punitive and contain safeguards to protect the source(s) of the data.

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

### 4. DEFINITIONS

- 4.1 Flight Data Analysis: A process of analyzing recorded flight data in order to improve the safety of flight operations;
- 4.2 Flight Data Monitoring (FDM): It is the systematic, pro-active and non-punitive use of digital flight data from routine operations to improve aviation safety;

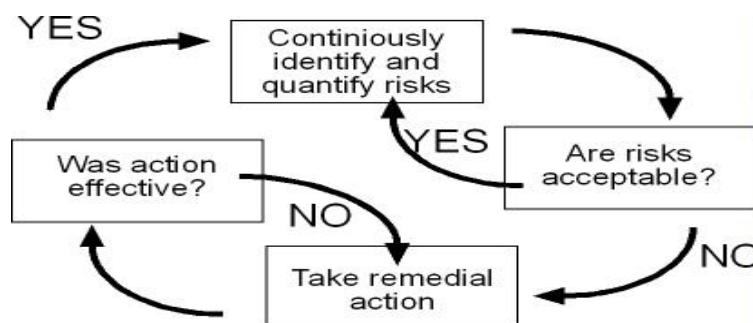
- 4.3 FDM Event/Exceedence: It is circumstances detected by an algorithm looking at FDR data;
- 4.4 FDM Parameter Analysis: Measurements taken from every flight e.g. maximum g at landing;
- 4.5 Hazard: A physical situation, often following from some initiating event, that can lead to an accident;
- 4.6 Incident: An occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation;
- 4.7 Risk: It is the combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence;
- 4.8 Risk Assessment: Assessment of the system or component to establish that the achieved risk level is lower than or equal to the tolerable risk level;
- 4.9 Safety Assessment: A systematic, comprehensive evaluation of an implemented system to show that the safety requirements are met;
- 4.10 Safety Objective: A safety objective is a planned and considered goal that has been set by a design or project authority;
- 4.11 Safety Policy: Defines the fundamental approach to managing safety and that is to be adopted within an organisation and its commitment to achieving safety;
- 4.12 Severity: The potential consequences of a hazard;
- 4.13 System: A combination of physical components, procedures and human resources organised to achieve a function;
- 4.14 Validation: The process of determining that the requirements are the correct requirements and that they are complete;
- 4.15 Verification: The evaluation of the results of a process to ensure correctness and consistency with respect to the inputs and standards provided to that process.

## **5. FLIGHT DATA MONITORING (FDM)**

- 5.1 Flight Data Monitoring is the systematic, pro-active and non-punitive use of digital flight data from routine operations to improve aviation safety.
- 5.2 Flight Data Monitoring is a process that includes:
  - a) The acquisition, measurement and analysis of flight data in order to identify, establish probable causes for, and rectify adverse trends and deviations from accepted norms of flight operations and safety;
  - b) The capability to more thoroughly understand flight operations by tracking trends, and investigating the circumstances relating to minor incidents;
  - c) The detection of risk factors before they lead to major incidents, and to develop preventative and/or corrective actions such as increased training or changes in in-flight operating procedures. In short, the flight data monitoring process is a closed loop system that provides a means for the continual monitoring and improvement of the safety of flight operations and performance.
- 5.3 Main Reasons for implementing Flight Data Monitoring
  - a) To comply with Regulatory FDM requirement (ICAO Annex 6 Part 1);
  - b) Main benefits that can be derived from FDM:
    - o Increased safety oversight;
    - o Operational improvements;
    - o Fuel savings;
    - o Improved Engine Condition Monitoring;
    - o Reduced maintenance costs;
    - o More focused training.

## 6. OBJECTIVES OF AN OPERATOR'S FDM SYSTEM

- 6.1 Flight Data Monitoring (FDM) programmes assist an operator to identify, quantify, assess and address operational risks. A FDM system allows an operator to compare their Standard Operating Procedures (SOPs) with those actually achieved in everyday line flights.
- 6.2 A feedback loop, preferably part of a Safety Management System (SMS), will allow timely corrective action to be taken where safety may be compromised by significant deviation from SOPs.
- 6.3 The FDM system should be constructed so as to:
- Identify areas of operational risk and quantify current safety margins.  
Initially a FDM system will be used as part of an operator's System Safety Assessment to identify deviations from SOPs or areas of risk and measure current safety margins. This will establish a baseline operational measure against which to detect and measure any change.  
Example: Current rates of rejected take-offs, hard landings, unstable approaches.
  - Identify and quantify changing operational risks by highlighting when non-standard, unusual or unsafe circumstances occur.  
In addition to highlighting changes from the baseline, the system should enable the user to determine when non-standard, unusual or basically unsafe circumstances occur in operations.  
Example: Increases in above rates, new events, new locations.
  - To use the FDM information on the frequency of occurrence, combined with an estimation of the level of severity, to assess the risks and to determine which may become unacceptable if the discovered trend continues.  
Information on the frequency of occurrence, along with estimations of the level of risk present, is then used to determine if the individual or fleet risk level is acceptable. Primarily the system should be used to deduce whether there is a trend towards unacceptable risk prior to it reaching risk levels that would indicate the SMS process has failed.  
Example: A new procedure has introduced high rates of descent that are approaching the threshold for triggering GPWS warnings. The SMS process should have predicted this.
  - To put in place appropriate risk mitigation techniques to provide remedial action once an unacceptable risk, either actually present or predicted by trending, has been identified.  
Once an unacceptable risk, either actually present or predicted by trending, has been identified, then appropriate risk mitigation techniques must be used to put in place remedial actions. This should be accomplished while bearing in mind that the risk must not simply be transferred elsewhere in the system.  
Example: Having found high rates of descent the Standard Operating Procedures (SOPs) are changed to improve control of the optimum/maximum rates of descent being used.
  - Confirm the effectiveness of any remedial action by continued monitoring.  
Once a remedial action has been put in place, it is critical that its effectiveness is monitored, confirming that it has both reduced the original identified risk and not transferred the hazard elsewhere.  
Example: Confirm that the other measures at the airfield with high rates of descent do not change for the worse after changes in approach procedures.



## **7. TYPICAL FDM SYSTEMS FOR FLIGHT ANALYSIS**

- 7.1 Integrated software solutions are available commercially, offering comprehensive measurement, analysis, and reporting tools that can benefit all types of aircraft operators. These packages are designed to meet Regulatory requirements for FDM (Flight Data Monitoring). Initially the program decodes the recorded data collected from an aircraft DFDR / QAR into engineering values. Thereafter, a flight analysis program enables easy reconstruction of the flight, comparing the recorded data with the recommended values retrieved from the flight profile, and highlights abnormal events and deviations. Several vendors offer solutions that perform all the major functions of the flight data monitoring process, including data processing, flight analysis and reporting, and flight data animation.
- 7.2 Visualization tools reconstruct the aircraft profile, enabling easy replay and review of flight information, while a user-configurable reporting module provides a range of comprehensive and customizable reports. By accurately processing and analyzing flight data, the software allows operators to evaluate flight operations trends, identify risk precursors, and make information-based decisions to enhance operations and increase safety. The output information may be directly utilized for:
- a) Exceedence Detection;
  - b) Routine Data Measurements;
  - c) Incident Investigation Data;
  - d) Continued Airworthiness Investigation Data.

## **8. THE IMPLEMENTATION PLAN**

- 8.1 The following is a broad guide to the major steps involved in putting an FDM programme in place. The key steps are getting buy in at the top level of management, a good team with crew participation, clear objectives and specification and finally, rigorous testing and verification procedures for the resulting data.
- a) Confirm CEO approval and support for FDM implementation;
  - b) Identify Key team members;
  - c) Agree Aims and Objectives;
  - d) Develop crew agreements and involvement;
  - e) Conduct feasibility study and develop business plan(people, processes, software and hardware);
  - f) Obtain funding and organisational approval;
  - g) Survey key areas in Operation for targets of opportunity;
  - h) Produce detailed specification and place contracts;
  - i) Put in place operating procedures;
  - j) Installation of airborne equipment (if required);
  - k) Provision of ground analysis station;
  - l) Conduct staff training;
  - m) Test data acquisition and analysis, complete manuals;
  - n) Produce Completion Report.

## **9. FDM FUNCTION AND MODALITIES**

### **9.1 The Information Database**

All the information gathered should be kept either in a central database or in linked databases that allow cross-referencing of the various types of data. These links should include air safety and technical fault reporting systems to provide a complete view of the operation.

### **9.2 Operator's Departments - Assessment and Follow-up**

This is the critical part of the process. Given the systems are put in place to detect, validate and distribute the information; it finally reaches the areas where the safety and continued airworthiness benefits may be realised. The data must be assessed using first hand knowledge of the operational or airworthiness context in which it is set. Final validation done at this informed level may still weed out some erroneous data.

### **9.3 Remedial Action**

Once a hazard or potential hazard has been identified, then the first action has to be to decide if the level of risk is acceptable. If not, then appropriate action to mitigate the effect should be investigated along with an assessment of the fuller effects of any proposed changes. This

should ensure the risk is not moved elsewhere. The responsibility for ensuring action is taken must be clearly defined and those identified must be fully empowered.

#### 9.4 Continued Monitoring

Once any action is taken, then an active monitor should be placed on the original problem and a careful assessment made of other hazards in the area of change. Part of the assessment of the fuller effects of changes should be an attempt to identify potential relocation of risks. This, plus a general monitor on all surrounding measures is required before "signing off" the change as successful. This confirmation, or otherwise, would be expected to feed into a high level management group to ensure remedial action takes place.

### 10. FDM WITHIN A SAFETY MANAGEMENT SYSTEM

The principles behind successful Safety Management Systems (SMS) are the same as those for FDM programmes that have been proven to function much more effectively within an integrated risk management system.

#### 10.1 The Initial Risk Assessment

Knowledge of the current operation is needed to formulate an assessment of the total risks falling upon the operator. This can be gained, in part, using a carefully implemented FDM programme that will provide identification and measures to support expert opinion and experience. All available sources of safety data should be utilised to better model the risk environment. The better the understanding of risk, especially at the less obvious lower risk levels, the more likely that potential risks will be highlighted and in those areas mitigation techniques can be developed.

#### 10.2 FDM Provides Definitive Risk Data to Validate Assumptions

The success of any SMS requires knowledge of actual operations and cannot be achieved using assumed safety performance. One cannot know with any certainty that, because one audit point, say a check flight, measures up to standards, that the other 1000 flights will also be satisfactory. In monitoring all flights, FDM can help to fill in this missing information and assist in the definition of what is normal practice. This gives assurance that SMS is managing actual rather than perceived safety issues.

#### 10.3 Benefit from Incorporation FDM within a SMS

SMS Provides a Structured Environment for a FDM Implementation and use of data analysis techniques enable a more formal process to be constructed along the lines of other SMS processes for recognizing and resolving significant safety issues. A Summary of SMS Benefits from the Implementation of FDM is given below:

- a) Gives a knowledge of actual operations rather than assumed;
- b) Gives a depth of knowledge beyond accidents and incidents;
- c) Setting up a FDM program gives insight into operations;
- d) Helping define the buffer between normal and unacceptable operations;
- e) Indicates potential as well as actual hazard;
- f) Provides risk-modelling information;
- g) Indicates trends as well as levels;
- h) Can provide evidence of safety improvements;
- i) Feeds data to cost-benefit studies;
- j) Provides a continuous and independent audit of safety standards.

#### 10.4 Management and Crew's Responsibility to Act upon Knowledge

Once an area of risk has been identified then a documented / trackable decision must be made. Either remedial action should be taken, projecting the likely reduced risk, or justification for maintaining current status. Without this process in place, then the consequences of not acting upon risk information may be severe.

#### 10.5 Good Written Agreements - Not Over Detailed but Strong on Principles

It is important that the underlying principles to be applied are understood by all parties and signed up to, early in the process. Once this is done, when problems or conflicts of interest arise, they form the foundation of practical solutions. An operator-crew agreement is recommended so that everyone involved know the limits which the agreements place on them. In uncertain cases there should be an accepted procedure by which a course of action can be approved.

## 11. THE FDM TEAM

11.1 Industry experience has shown that the 'team' required to run an FDM programme can vary in size from one person to a small department, as a function of fleet size. In addition to their existing subject area expertise, all staff should be given at least basic training in the specific area of FDR data analysis. It is essential that a regular, realistic amount of time is allocated to FDM tasks. Lack of manpower resources usually results in underperformance or even failure of the whole programme. In the case of a very small operator the day to day running of the programme may be contracted out to a third party, thus removing the data handling and basic analysis tasks. However, sufficient expertise must remain within the operation to control, assess and act upon the processed information received back from the other company. Responsibility for action may not be delegated.

a) Team Leader

This person will be trusted by and given the full support of both management and crews. They may have direct crew contact in situations that require diplomatic skills;

b) Flight Operations Interpreter

This person will normally be a practising or very recent pilot, possibly a senior Captain or trainer, who knows the company's route network and aircraft. Their in depth knowledge of SOPs, aircraft handling characteristics, airfields and routes will be used to place the FDM data in context;

c) Airworthiness Interpreter

This person will interpret FDM data on technical aspects of the aircraft operation;

d) Crew Liaison Officer

This person will be the link between the fleet or training managers and aircrew involved in circumstances highlighted by FDM. This person is often a Airline Pilot's Association or other staff representative with good people skills and a positive attitude towards safety education;

e) Engineering Technical Support

This will be an individual who is knowledgeable about the FDM and associated systems needed to run the programme. An avionics specialist normally is also involved in the supervision of mandatory FDR system serviceability.

## 12. ORGANISATION AND CONTROL OF FDM INFORMATION

12.1 As with all information systems, it is critical that the data flows are tightly controlled by clear procedures. Careful thought has to be given to the practicalities and possible disruptions involved in getting data from the aircraft and translated to useful information for safety managers. Additionally, much of the data has to be treated confidentially with access carefully restricted to those authorised to view it. These exceptions to normal operating practice, good airmanship and flight manual limitations will be highlighted ready for evaluation and action.

## 13. RATIONALISED DATA STREAM

### 13.1 Regular Replay Schedule

Downloaded data should be replayed to a regular schedule to avoid build ups. Batch processing of a number of files may be a practical method of initial replay and analysis if the system is suitably automated.

### 13.2 Initial Verification of Data

The first step in the investigation process is to ensure the information is realistic and presents a consistent picture. **VALIDATION IS CRITICAL.** Before any action is instigated the basic FDR information must be thoroughly checked. Well written FDM software should automate as much of this process as practical.

### 13.3 Identification of Urgent Actions

There are a number of circumstances where FDM data will indicate that immediate safety action is required and a fast procedure to ensure safety critical remedial action should be defined. In general, the urgent actions are associated with Continued Airworthiness checks, rather than operational situations. For example, a very heavy landing with potential damage that has not been reported by other means should trigger relevant structural checks as soon as possible, whereas crew remedial investigations are not so urgent.

#### 13.4 Allocation of Follow-up Co-ordinator

Once a basic assessment has been carried out and has revealed a significant risk, or aspect requiring further investigation, then one particular person or department should be allocated follow-up responsibility.

#### 13.5 Database all Results

The results of all analysis should be placed on a database ready for interpretation and further analysis.

#### 13.6 Record all Actions Taken

An important part of the assessment of a new FDM system and an integral part of a fully functioning system within a SMS is the careful recording of all actions arising from the data. This can be used to help demonstrate the benefits accrued and also ensure an audit path to confirm remedial actions have taken place.

#### 13.7 Replay Statistics

Part of the replay process should be the recording of statistics on replay coverage, individual aircraft reliability, general data quality measurements. Differences in replay success/errors between aircraft can help indicate where remedial engineering action is required. These statistics are required to allow the derivation of overall and specific event rates; airfield and aircraft specific rates etc.

### 14. DATA FLOW

The data flow should be optimised to minimise the delay between the flight and data analysis. This will ensure timely recognition of serious incidents that may need prompt action - for example a structural inspection - and increase the likelihood of the crew remembering the surrounding circumstances.

### 15. DATA SECURITY AND CONTROL

#### 15.1 Defined Policy on Retention of Data

Because of the large volumes of data involved, it is important that a strategy for data access, both on and off line, is carefully developed to meet the needs of the system users.

#### 15.2 Link with the Air Safety Reporting Process

This is required to allow relevant crew Air Safety Reports (ASR) to be automatically added to FDM information. The crew should be encouraged to submit an ASR without prejudice via a confidential contact method.

#### 15.3 Engineering use of FDM Data

It must be recognised that the use of FDM and associated data sources for Continued Airworthiness purposes is an important component of the system. However, secure procedures must be in place to control access to the identified data and how the data is used. Identification of and contact with crews for operational rather than technical follow-up of FDM data should not be permitted through this path.

#### 15.4 Defined De-identification Policy and Procedures

This is an absolutely critical area that should be carefully written down and agreed before needed in extreme circumstances. Management assurance on the nondisclosure of individuals must be very clear and binding. The one exception is when the operator/crew team believe that there is a continuing unacceptable safety risk if crew specific action is not taken. In this case an identification and follow-up action procedure, previously agreed before the heat of the moment, can be brought into play.

#### 15.5 Crew Identification in Mandatory Occurrences

An exception to the de-identification of FDM data should be made when there is an incident that is subject to a Mandatory Occurrence Report. In this case the identified data must be retained for any subsequent safety investigation. A safety rather than disciplinary approach should to be taken in these cases.

#### 15.6 Set Authorised Access Levels

The FDM system must have the ability to restrict access to sensitive data and also control the ability to edit data. The System Administrator should have full access, while operations

management may only have sight of de-identified data and the ability to add comments and edit a few appropriate fields. Similarly the replay technician will be able to feed in new data, check identification etc. but will not be able to change program specifications and event limits. Continued Airworthiness and operations would have particular views of the data, perhaps with the former being airframe identified, while the latter would be say, pilot group.

## **16. CREW PARTICIPATION**

### **16.1 Agree Joint Aim - to Improve Safety and Non-punitive**

It is fundamental that all involved in FDM agree the aims and objectives of the work and the self-imposed restrictions which operate.

### **16.2 Flexible Agreement**

It has been found that agreements of principles, with plain English definitions of the areas covered, exclusions and conditions of use, are far more workable than a rigid set of rules that impede progress. Based on trust and mutual consent, all parties should view the data access as privileged and handle it carefully.

### **16.3 Defined Procedure for Restricted Contact with Flight Crew**

A step by step description of the restricted method by which crews are contacted and the safeguards in place should be publicised to gain crew confidence. Flight crews should be encouraged to talk through difficult situations and learn from experience, even to ask for data about their flying.

### **16.4 Discrete Retraining of Individuals where Required**

Where it is agreed with the individual that retraining is appropriate then this should be scheduled into the training programme in a discrete manner to avoid highlighting the person. It must be stressed that additional training is not to be considered disciplinary action but merely a safety improvement action.

### **16.5 Confidentiality**

A statement of agreement outlining the protection of the identity of the individual should be clearly written, along with any provisos necessary.

### **16.6 Define Confidentiality Exceptions**

It would be irresponsible to guarantee total confidentiality in a situation where there would be significant ongoing risk to safety. In the case of grossly negligent behaviour, where the crew have "failed to exercise such care, skill or foresight as a reasonable man in his situation would exercise", then action to prevent repetition should be agreed by a pre-defined group that would usually include crew representatives. Formal action may be required by law.

### **16.7 Inform Crew**

At all times keep the crew informed of areas of concern and remedial actions contemplated. Their involvement and ideas will usually ensure a workable solution to operational problems that they have experienced and ensure future buy in to the programme.

### **16.8 Feedback on Good Airmanship**

Where examples of good flying have been found then these should be highlighted and commented upon. They also make useful reference material when analysing or debriefing less well executed flights.

## **17. INTERPRETATION OF RESULTS - THE OPERATIONAL ASSESSMENT**

### **17.1 Degree of Direct or Indirect Hazard**

It is best if the degree of hazard is estimated to enable resources to be targeted at the most beneficial reduction in hazard. This may be to prevent a large number of relatively low risk events or to eliminate a low number of high risk events. In assessing the level of risk, the analyst must take into account both the direct risks and those that may be a consequence of those circumstances.

#### 17.2 Assess Potential Accident Factors

It is useful if a list of precursors of and causal factors in previous accidents is drawn up to further highlight potential hazards. These again may be relatively low risk events in their own right but good indications of the probability of further, more significant incidents.

#### 17.3 Assess Frequency - Single Event Or Systematic Problem

The events should be assessed in the context of previous experience. One of a series showing a trend or a one-off incident in exceptional circumstances. Clusters of events may occur at a particular airfield, on one aircraft or during a period of bad weather. By placing all events on a database will enable the analyst to decide an informed course of action.

#### 17.4 Taking Action - The Decision Process

As with any safety report, the responsible analyst must decide if it is appropriate to take action to prevent repetition. Action could be required due to safety severity (through individual risk or high frequency), financial or operational implications. Actions and the underlying reasons and data used should be recorded to provide an audit path.

### 18. MANDATORY OCCURRENCE REPORTING AND FDM

#### 18.1 Air Safety Reports (ASRs)

The incident reports initially submitted to the operator's flight safety officer. The processing, assessment and actions arising from each ASR will form part of the operator's Safety Management System. ASRs are raised by a wide range of methods and triggers. A flight crew or air traffic controller's assessment of a risk, the result of an engineer's inspection, cabin crew reports, security staff etc. all contribute to an overall awareness of the safety risk to the operation. Be aware that an incident may be reported in one or more reporting systems e.g. ground report, maintenance, human factors, cabin crew etc. and that an integrated system will bring together all the relevant information. Reports could indicate failure of the defensive measures you have put in place to prevent a hazard

#### 18.2 Mandatory Occurrence Reports (MORs)

The more significant ASRs (along with maintenance and other reports) will be noted, either by the person submitting the report or the safety officer, as requiring submission to the CAA's MOR Scheme. These reports are further considered, acted upon and publicised to increase awareness.

#### 18.3 Retention of FDR data for MORs

After an incident, a quick judgement has to be made as to whether FDR data is likely to be useful in an investigation. The short recycling/overwriting time of most DFDRs makes it critical that a decision to quarantine the data is taken very rapidly. Experience shows that this is a very difficult requirement to fulfil. Where QAR data is available it is suggested that operators may wish to approach the CAA with a proposal to substitute QAR data for that from the DFDR.

#### 18.4 Confidentiality Issues

While all ASRs are attributable to the reporter, an open safety reporting culture relies on the knowledge that the identification of individuals is restricted to a need-to-know basis and that it is definitely non-punitive.

It should be noted that there is a difference between anonymity and confidentiality with the former being less desirable in an integrated safety system. While the reports generated automatically from FDM programmes should be treated confidentially, the greatest benefit will be gained by correlating this information with other relevant safety and technical reports especially in the case of the most hazardous or significant events.

#### 18.5 Withdrawal of Protection of Identity

Experience has shown that very rarely there will be cases where an important issue has been raised by FDM and for some reason no report has been submitted. In this case the persons involved have been encouraged, through a confidential contact by a crew representative or other trusted person, to submit, "without prejudice", a report. This method of contact has proved to be very effective in soliciting reports and a good means of imparting constructive safety advice to those involved.

#### 18.6 Confidentiality and Mandatory Occurrence Reports

It should be noted that while MORs are not subject to FDM confidentiality agreements, it is possible to submit a confidential MOR. In this way, although the original report must be identified, this information will be restricted during subsequent publication and analysis. Within a good safety culture the vast majority of significant Individual FDM events/exceedences will be the subject of crew air safety or occurrence reports and investigations.

### 19. REPORTING STANDARDS AND AUDIT EVENTS

19.1 FDM systems have proven to be very effective in reminding crews to submit reports during the early stages and are then a useful audit tool, confirming reporting standards in an established programme. Issues covered may include the following:

- a) Various warnings: Stall, Hard GPWS, high speed or major systems warning
  - b) Heavy landing
  - c) Tailscrape
  - d) Rejected take-off at high speed and go-arounds
  - e) Engine failure
  - f) Severe turbulence and vortex wake encounters
  - g) Altitude deviation
  - h) Flight control difficulties indicated by excessive/untypical control deflections
- It should be remembered that in the case of significant incidents found as the result of FDM analysis, the crews should be encouraged to submit retrospective reports - without prejudice or penalty to the crew concerned.

### 20. REFERENCES

- a) ICAO Annex 6 pt-1
- b) UKCAP 739

### 21. IMPLEMENTATION

This Air Navigation Order shall be implemented with immediate effect and supersedes ANO 91-0028 Issue -1.

--S/d--

**(M. JUNAID AMEEN)**  
Air Commodore (Retd.)  
Director General,  
Pakistan Civil Aviation Authority

Dated: 18<sup>th</sup> Sept, 2009

## Appendix 'A'

**PROGRAMME EXCEEDENCE DETECTION AND ROUTINE PARAMETER ANALYSIS****1. Traditional Event Set**

These operational events are typical of those found in most software packages; however events should be tailored to the specific needs / peculiarities of the air operator and its operation.

<b>Event Group</b>	<b>Event Code</b>	<b>Description</b>
Flight Manual Speed Limits	01A	Vmo exceedance
	02A	Mmo exceedance
	03A	Flap placard speed exceedance
	03G	Gear down speed exceedance
	031	Gear up / down selected speed exceedance
Flight Manual Altitude Limits	04	Exceedance of flap / slat altitude
	05	Exceedance of maximum operating altitude
High Approach Speeds	06A	Approach speed high within 90 sec of touchdown
	06B	Approach speed high below 500 ft AAL
	06C	Approach speed high below 50 ft AGL
Low Approach Speed	07A	Approach speed low within 2 minutes of touchdown
High Climb-out Speeds	08A	Climb out speed high below 400 ft AAL
	08B	Climb out speed high 400 ft AAL to 1000 ft AAL
Low Climb-out Speeds	08C	Climb out speed low 35 ft AGL to 400ft AAL
	08D	Climb out speed low 400 ft AAL to 1500 ft AAL
Take-off Pitch	09A	Pitch rate high on take-off
Unstick Speeds	10A	Unstick speed high
	10B	Unstick speed low
Pitch	20A	Pitch attitude high during take-off
	20B	Abnormal pitch landing (high)
	20C	Abnormal pitch landing (low)
Bank Angles	21A	Excessive bank below 100 ft AGL
	21B	Excessive bank 100 ft AGL to 500 ft AAL
	21C	Excessive bank above 500 ft AGL
	21D	Excessive bank near ground (below 20 ft AGL)
Height Loss in Climb-out	22D	Initial climb height loss 20 ft AGL to 400 ft AAL
	22E	Initial climb height loss 400 ft to 1500 ft AAL

Slow Climb-out	22F	Excessive time to 1000 ft AAL after take-off
High Rate of Descent	22G	High rate of descent below 2000 ft AGL
Normal Acceleration	23A	High normal acceleration on ground
	23B	High normal acceleration in flight flaps up / down
	23C	High normal acceleration at landing
	23D	Normal acceleration; hard bounced landing
Low go-around	024	Go-around below 200 ft
RTO	026	High Speed Rejected take-off
Configuration	40C	Abnormal configuration; speed brake with flap
Low Approach	042	Low on approach
Configuration	43A	Speedbrake on approach below 800 ft AAL
	43B	Speedbrake not armed below 800 ft AAL (any flap)
Ground Proximity Warning	44A	GPWS operation – hard warning
	44B	GPWS operation – soft warning
	44C	GPWS operation – false warning
	44D	GPWS operation – windshear warning
Margin to Stall	45A	Reduced lift margin except near ground
	45B	Reduced lift margin at take-off
	46A	Stickshake
	46B	False stickshake
Configuration	047	Early configuration change after take-off (flap)
Landing Flap	48A	Late land flap (not in position below 500 ft AAL)
	48B	Reduced flap landing
	48D	Flap load relief system operation
Glideslope	56A	Deviation under glideslope
	56B	Deviation above glideslope (below 600 ft AGL)
Buffet Margin	061	Low buffet margin (above 20,000 ft)
Approach Power	75A	Low power on approach

## 2. Operational Event Program Triggers

In addition to the traditional events detailed above there could be a number of new events used to detect other situations which an air operator may be interested in. Some of the new triggers are relatively simple to implement while others would need careful coding and research to avoid false events while still activating against good data.

Description	Notes
Engine Parameter excellence (eg TGT etc)	One of a range of engine monitors
Full and free control checks not carried out	Essential pilot actions and a measure of control transducers.
Taxi out to take-off time – more than (x) minutes	Can be measured against a standard time for that airfield and runway.
<b>High Normal Acceleration – Rough taxi-way</b>	Detection along with an estimate of position derived from groundspeed and heading.
High Longitudinal Acceleration – Heavy braking	As above
Excessive Taxi Speed	As above
Take-off configuration warning	
Landing gear in transit longer than (x) seconds	To be used as an indicator of system problems and wear
Flap / slats in transit longer than (x) seconds	As above
Master Warning	All master warnings, even if false, heard by the crew are a useful indicator of distractions and “mundane/known problems”.
Engine failure	To determine crew performance as well as help technical investigation.
Autopilot vertical speed mode selected below (x) ft	One of a range of auto flight system usage monitors
Fuel Remaining at landing below minimums	
Airborne holding – more than (x) minutes	
Excessive control movement – airborne (especially rudder)	This will indicate control problems that other events might not identify
TCAS warning	A must for monitoring future significant hazards and crew reactions
Reverse thrust not used on landing	
Auto ground spoiler not selected for landing	
Landing to shutdown time – more than (x) minutes	Indicates taxiway or stand allocation problems