

## **CHAPTER 11 – PREVENTIVE MEASURES AND ANALYSIS**

### **APPLICATION OF TERMINOLOGY**

1. Common terminology accepted by the CF shall, with few exceptions, meet the aims of this manual and maintain consistency. Where terms or words have taken on meanings specific to FS, they are defined below.

### **ANALYSIS PURPOSE**

2. The goal of the FS System is to prevent accidental loss of CF aviation resources. The analysis and subsequent PM steps are the most important of investigation activities because the successful implementation of PMs is means to achieve the goals of the FS Program and the Airworthiness Investigation activity. This is met through the clear identification of hazards and the effective implementation of practicable PMs. Such measures normally modify some aspect of procedures in the manufacture, support, operation or maintenance of aircraft or components. Further, by investigating occurrences, the FS System obtains valuable feedback and develops PMs so that similar occurrences can be reduced, mitigated and ideally eliminated. Feedback also allows lessons learned by a unit to be used by other units not directly involved and raise the awareness of personnel.

3. FSOs at all levels should make every effort to ensure that PMs / corrective actions are monitored to ensure they are implemented and assessed for effectiveness. Feedback shall be provided to subordinate units and HQ as to the status and effectiveness of these measures.

### **DEFINITION**

#### **PREVENTIVE MEASURE (PM)**

4. A PM is any step that can be taken to decrease the likelihood of a FS occurrence.

#### **NOTE**

When practical, one or more PM may be applied to each cause factor assigned to an occurrence. While there has to be a correlation between the cause factor(s) and the PMs assigned there is no requirement to assign a PM for each cause factor assigned. Notwithstanding, the combination of the PMs assigned should minimize the risk of a repeat of the contributing cause factors.

### **ANALYSIS METHODOLOGY**

5. Most types of analysis involve statistics. Statistics can be misleading, and methods for avoiding the more common pitfalls are described in the paragraphs that follow. It is suggested the following data be considered:

- a. the number of occurrences involving a formation in any given period;

- b. the most common types of occurrences and cause factors (look for trends and their root causes);
- c. the most common PM (have they been implemented and are they effective?);
- d. trends in individual aircraft and / or components, equipment, stages of operation, units, sections and personnel and the probable reasons for these trends;
- e. environmental and seasonal factors; and
- f. the effects of exercises, competitions and deployments.

#### **OCCURRENCE RATE**

6. The rate of occurrences is expressed as the number of occurrences per 10,000 flying hours. It is calculated with the formula: (# of accidents) / (incidents) / (occurrences) X 10000 ÷ (# flying hours). E.g. four air accidents in 30,000 flying hours would result in an accident rate of 1.33.

#### **ANALYSIS OF LOCAL OCCURRENCES**

7. Comds and FSOs at every level must evaluate the effectiveness of their FS Programs. To achieve this, FSOs must maintain records of every FS occurrence involving facilities, equipment and personnel. The FSOMS is the primary tool used to aid this process and is useful for identifying trends.

#### **ANALYSIS AVAILABLE FROM FSOMS**

8. The FSOMS trending tools can provide FS staff with a comprehensive range of data for use in identifying problem areas and implementing PMs. FSOs can contact DFS either directly or through their WFSO for assistance in generating or interpreting an analysis.

#### **USE OF RESULTS**

9. Regular in-depth analysis can indicate where additional PMs are required. Recommendations should be made to the first level authorized to implement them

#### **PM MANAGEMENT PROCESS**

10. PMs are the final outcome from investigations (for both Occurrences and Hazards) which, when implemented may prevent accidents. Considering this is the ultimate aim of the entire Flight Safety program, there needs to be a formal management process to address PMs from formulation to final closure.

11. Annex B details the process flow for the development and tracking of PMs to completion.

#### **DEVELOPMENT OF EFFECTIVE PM**

12. PMs are to be implemented so that they will have lasting effects despite frequent changes in personnel. New accidents are rare; usually it is simply a matter of new people being involved in "old" accidents. Short-term PMs, such as briefing aircrew or maintenance

personnel, have little lasting effect and may allow hazards to reoccur when new people arrive.

13. The guidelines for developing effective PM are listed below:
  - a. the PM should, when applicable, target the lowest level in the chain of command that is able to deal effectively with the PM;
  - b. the PM must treat the cause of a problem and not its effect;
  - c. the PM must be realistic and practicable, and their effects on operational capability should be considered. PM must also be judged according to cost-effectiveness, training and manpower requirements and implementation time;
  - d. the PM need not be limited to the cause of a specific incident, as other hazards may surface during the course of an investigation;
  - e. the occurrence resulting from personnel cause factors should lead to a search for PMs in management, training and supervision;
  - f. the PMs resulting from an occurrence should be consistent with and developed logically from the cause;
  - g. similar occurrences in the past or with other fleets should be reviewed for ideas
  - h. the organization responsible for ensuring that PMs are completed should be identified and target dates set for all follow-up action
  - i. when a hazard is identified that requires immediate action, comds and FSOs should address the particular problem immediately and independently;
  - j. units shall action PMs contained in SRs from other units if applicable; and
  - k. lessons learned shall be identified and disseminated when applicable
14. When preparing the SR, the FSO should focus on PMs that can truly mitigate or eliminate the chance of future accidents, like improving a training syllabus, amending SOPs and modifying equipment, to name a few.

15. The Human Factors Intervention matrix (HFIX®) is a tool that can be used for mapping intervention strategies related to the human errors identified in the H ACS model. HFIX can help a FSO to systematically generate comprehensive PMs that directly target the underlying systemic causes of errors. The HFIX matrix has been posted on the DFS Web site under the FSOMS Ops Guidance page at [http://airforce.mil.ca/fltsafety/fsoms/docs/HFIX\\_Checklist.pdf](http://airforce.mil.ca/fltsafety/fsoms/docs/HFIX_Checklist.pdf)

## **REVIEWING PM**

### **1 Cdn AIR DIV REVIEW**

16. On review of the occurrences and hazards reported, 1 Cdn Air Div will:
  - a. implement the appropriate PMs within their authority;
  - b. recommend additional PMs and, where applicable, identify the responsible offices and target dates for follow-up action
  - c. provide recommendations for PMs that are beyond their capabilities; and
  - d. consider whether or not specific PMs should also apply to other aircraft types under their comd.

## **DFS REVIEW**

17. On review of the occurrences and hazards reported, DFS shall:
  - a. coordinate with other agencies for action as necessary;
  - b. establish target dates for outstanding items;
  - c. disseminate PMs and information back to 1 Cdn Air Div, wings, bases, and units;
  - d. consider the application of PMs to other aircraft types; and
  - e. produce educational material for distribution to units.

## **RESPONSIBILITY FOR IMPLEMENTING PM**

18. Comds at all levels, with advice from their FS staffs, are responsible for devising and instituting PMs and for advising higher HQ of required PMs that are beyond local capabilities.

## **TRACKING OF PM**

19. Tracking means monitoring all PMs until they have been fully implemented or rejected by the appropriate authority. Tracking is the responsibility of Comds at all levels, with advice from their FS staffs. Tracking also ensures that the entire user community is kept up to date on the nature, status and effectiveness of PMs. Additionally, it ensures that PMs are not forgotten. Further guidance is provided at Annex B.

## **MAPPING CF DATA TO ICAO DATA**

20. For data comparison and exchange of information, the FSOMS is required to be mapped to ICAO data. Annex A details the relationship between the CF occurrence categorization system and the ICAO occurrence categorization system.
21. In order to map FSOMS data to ICAO data, CF FS occurrences are divided into three major occurrence classes. Appendix 1 to this Annex details the specific mapping
  - a. 100 Accident Class. A 100 accident is defined as any occurrence categorized as an "A", "B" or "C" category occurrence. It involves a CF aircraft, its equipment or its operation having caused someone to be missing (Grey) or have received fatal (Black), very serious (Red) or serious (Yellow) injuries or illness, or where the CF aircraft is either destroyed, missing or left with serious damage which adversely affects the structural strength, performance or flight characteristics of the aircraft and would normally require major repair or replacement of the affected component(s).
  - b. 200 Serious Incident Class. A 200 serious incident is defined as any "D" or "E" category occurrence involving a CF aircraft, its equipment or its operation where there was extreme to medium potential for a serious accident or where someone received a minor injury or where the CF aircraft sustained minor damage. A list of likely serious incidents can be found at Appendix 1 of Annex A.

- c. 300 Incident. A 300 incident is defines as any “D” or “E” category occurrence involving a CF aircraft, its equipment or its operation where a low potential for an accident or serious incident existed.

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**ANNEX A – MATRIX MAPPING CF OCCURRENCES TO ICAO DATA**

OCCURRENCE CATEGORY	SAFETY OF FLIGHT COMPROMISE	ICAO OCCURRENCE CLASS
A	YES	100 ACCIDENT
B		
C		
D, E	EXTREME TO MEDIUM	200 SERIOUS INCIDENT
D, E	Low TO NIL	300 INCIDENT

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## **APPENDIX 1 – LIST OF SERIOUS OCCURRENCES**

1. The incidents listed are typical examples of incidents that are likely to be serious. The list is not comprehensive and only serves as guidance to the definition of serious incident
  - a. Near collisions requiring an avoidance manoeuvre to avoid a collision or an unsafe situation or when an avoidance action would have been appropriate;
  - b. Controlled flight into terrain (CFIT) only marginally avoided (near CFIT)
  - c. Aborted take-off on a closed or occupied runway;
  - d. Take-off from a closed or occupied runway with marginal separation from obstruction;
  - e. Landing or attempted landing on a closed or occupied runway;
  - f. Gross failure to achieve predicted performance during take-off or initial climb;
  - g. Engine fire or fire and smoke in the passenger cabin or cargo compartment, even though such fires were extinguished with extinguishing agents
  - h. Event requiring the emergency use of oxygen by the flight crew
  - i. Aircraft structural failure or engine disintegration not classified as an accident
  - j. Multiple malfunctions of one or more aircraft systems seriously affecting the operation of the aircraft;
  - k. Flight crew incapacitation in flight
  - l. Fuel quantity requiring the declaration of an emergency by the pilot;
  - m. Incidents such as runway undershoot or overshoot or running off the side of a runway;
  - n. System failure, weather phenomenon, operation outside the approved flight envelope or other occurrences that could have made controlling the aircraft difficult; an
  - o. Failure of more than one system in a series of redundant systems mandatory for flight guidance and navigation

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## **ANNEX B – OCCURRENCE/HAZARD PM MANAGEMENT PROCESS**

Reference: C-05-005-P12/AM-001 *Policy and Procedures Aircraft Weapon Systems Engineering – Aerospace Equipment and Program Management Division Engineering Process Manual*, Part 12 Airworthiness Risk Management

1. This Annex details the steps required to develop and track PMs until completion. Although Hazards and Occurrence have completely different triggering mechanism (Proactive vs Reactive), the method used to resolve any noted deficiencies highlighted in the FS investigation will be through the formulation of PMs.
2. Although the procedures documented in this Annex standardize the PM management process across the CF, especially for PMs tasked above the wing, it is understood that each wing could use local procedures to deal with PMs within their sphere of responsibility. This is deemed acceptable provided the Chain of Command maintains visibility and responsibility for the implementation of PMs. Further, the intent of the principles described in this Annex are adequately documented in local unit/wing procedures (e.g. FS program, or AF9000 procedures).
3. This Annex should be read in conjunction with the flow chart at Appendix 1. This annex aims to achieve the following:
  - a. show how to identify risks to the chain of command (usually resulting from hazard reports);
  - b. describe the process to be used for validation of PMs;
  - c. describe how to transfer PMs addressed outside the unit;
  - d. detail the essential steps needed for traceability;
  - e. recommend a method to transfer the PMs from the FS network to the Chain of Command (CoC);
  - f. recommend a method for the CoC to task organizations under their command; and
  - g. describe the process to use when the CoC does not agree with the proposed PM.
4. Record of Airworthiness Risk Management (RARM). In the case of hazards, the reporting form (Chapter 7, Annex A) includes an identification of hazard “Severity” and “Probability”, which can be used to determine a level of risk according to the RARM (reference). The individual filing the hazard form will not necessarily be familiar with the risk management process; therefore the risk should be validated prior to be entered in FSOMS. If after an initial investigation of the hazard (Block H-4), the risk exceeds the acceptable level of safety, the information needs to be passed along to the Division FS office (Block H-6) within 48 hours. Following validation of the risk, the Division FS office will pass-on to information to the OAA (Senior Staff Officer Operational Airworthiness – SSO OA). The SSO OA will initiate

a risk evaluation and a RARM will be created if deemed necessary. In cases where a RARM is completed, a copy will be provided to the WFSO, to include the appropriate reference in FSOMS.

5. PM Validation Process. The validation process detailed in the flow chart (originated at block PM-1), has four steps:

- a. assignment of the PM to the proper FS level (UFSO, WFSO, Div FSO, or DFS);
- b. verification of the PM to determine if PM is acceptable and suggest the Action Organization (AO);
- c. pre-coordination of the PM between the FS network and the AO; and
- d. feedback to the investigator accepting and confirming the validity of each PM

6. PM Assignment Process. For all PMs with an AO outside the unit, the relevant PMs will be forwarded to the WFSO. Similarly, the WFSO will forward the PMs with AO outside the wing to the Div FS team, who will forward PMs with AO outside the Division's responsibility to DFS. It is expected that before a PM is passed to the next level (up the FS chain), the FS officer will ensure that the PM meets the criteria of an effective PM (Chap 11 para 13).

7. Third Line Contractor. In situations where PMs have to be implemented by a third line contractor, the following will apply:

- a. For simple & pre-coordinated PMs: the AO should be the Wing and the FSOMS tracking field for each PM should reflect that the contractor has agreed to implement the PMs; or
- b. For all other PMs: the staffing process detailed in para 6 applies and the AO should be the unit managing the contract with the applicable contractor (normally the Weapon System Manager).

8. PM Verification and Pre-coordination Process. Once the proper level is reached, the FSO of that organization will confirm that an appropriate AO has been assigned. In most cases, a pre-coordination should be performed with the AO, ensuring a buy-in from the start, and possibly a quicker implementation of the PMs. It must be noted that often, many PMs are implemented prior to the release of the final report. In a situation where the pre-coordination process is not completed on some PMs and the FS report is ready to be sent, the UFSO/WFSO can still release the FS report and select 1 Cdn Air Div/Div FS as the AO. Once the PM has been pre-coordinated with the appropriate AO by the Div staff, the FSOMS AO will be updated accordingly

9. PM Feedback Recording Process. For each PM staffed up the FS chain, there shall be a record providing feedback to the WFSO, confirming that the PM is valid and has the proper AO assigned.

10. PM Assignment to AO Above Wing. Once the final report is released (Block PM-2), the PM will be transferred formally (e-mail is acceptable) to the responsible FS organization level (Block PM-3). If the validation process was completed adequately, there should not be any PMs that were wrongly assigned; however it is possible that some PMs will be returned to the WFSO if the PM is not supported by the FS Chain (Block PM-11A).

11. PM Transfer to Chain Of Command (CoC). Following an investigation, a clear transfer of all PMs from the FS network to the appropriate level of the Chain of Command is required (Blocks PM-4 and PM-12).
12. PM Refusal or Modification. The responsibility to implement PMs rests with the CoC. In some cases, the implementation of a PM may not be possible or practical. In such situation, a PM may be refused, or modified in an attempt meet the original intent. In such a situation, correspondence with the appropriate FS level (Block PM-5A or PM-13A) should take place. If the FSO of the appropriate organization agrees with the recommendation or suggested modification, the rationale shall be inputted in FSOMS with the pertinent record and the PM closed or amended as required. However, if the FSO does not agree with the recommendation, he can raise his reasoning one level up in the chain of command (Bloc PM-5B and PM-13B), for final vetting.
13. PM Tasking by CoC. Once the PM have been accepted, a formal tasking should be done by the commanders at all levels. This is a necessary step that not only formally tasks the appropriate AOs, but confirms acceptance of the PM by the CoC
14. PM with Associated RARM. Even when the intent of a PM is met by a mitigating action of an approved/signed RARM, the PM will remain open and the tracking field in FSOMS shall include an appropriate comment, e.g. "RARM Ref #XX includes this PM as mitigating action #YY, with an expected completion date of DD/MM/YY. No updates on this PM will be done as part of the quarterly open PM Report. The assigned DFS desk officer will monitor during the yearly fleet review at the ARB." Once the specific mitigating action of the RARM is completed, the PM can be closed.
15. PM Closure. PM can be closed under the following conditions:
  - a. when the PM is implemented to the satisfaction of the responsible FS level (WFSO, 1 Div FSO, or DFS). Once a PM is completed, the AO will provide the specific records/documentation to the appropriate FS network. If the responsible FSO concurs, he will close the PM and include the details in FSOMS (Blocks PM-9 and PM-17). Also, the appropriate documentation will be forwarded to the FSO that originated the occurrence for tracking purposes; or
  - b. when the PM not to be implemented by the CoC has undergone the review detailed at para 12 above. The appropriate reference(s) showing the CoC refusal of the PM will be included in the FSOMS tracking field before closure of the PM
16. PM from Reports/Studies. In some cases, reports or studies are mandated as an individual PM. When such a report/study is formally released, that particular PM shall be closed; however, if PMs are resulting from this report/study, they shall be documented as new PMs within the same FS occurrence report that initiated this activity. PMs validation and pre-coordination is to be carried-out as described in this Annex. This will ensure that those follow-up actions are adequately tracked and recorded in FSOMS. Similarly, if an independent report/study has identified FS risks, a hazard report shall be generated in FSOMS if one or more PMs have been identified
17. Occurrence Report/Hazard Report Closure. Once all PMs for a specific Occurrence or Hazard are completed, that specific investigation will be formally closed in FSOMS, by the originating unit.

18. PM Tracking. Although the Commanders at all levels are responsible for the tracking of PMs, the FS staff will provide all necessary tools (regular reports) to facilitate this function, and ensure that no PMs are forgotten. For traceability purposes, the FS Representative will update FSOMS using the following guidelines stipulated in Table 1.

**NOTE**

In the case of Unsatisfactory Condition Report (UCR)/Publication Deficiency Report (PDR)/Statement of Capability Deficiency (SOCD) the PM will remain open until it is fully implemented on the fleet. IF the UCR/PDR/SOCD is rejected at higher level, the situation will be reviewed by the FS team as if the PM was rejected (para 11).

**NOTE**

For the purpose of tracking the PM, the responsible organization, in FSOMS, will change as the UCR/PDR/SOCD is staffed up the chain.

FLOW CHART BLOCK	ACTION TO RECORD	REQUIREMENTS
H-6	TRANSFER HAZARD TO CoC FOR RISK ASSESSMENT	DATE STAMP/FULL REFERENCE <sup>3</sup>
PM-4 & PM-12	PM TRANSFER TO CoC	DATE STAMP/FULL REFERENCE
PM-5A & PM-13A	PM REFUSED OR MODIFIED	FULL REFERENCE
PM-6 & PM-14	PM TASKED	DATE STAMP/FULL REFERENCE
PM-8 & PM-16	PM AUDIT (WHEN CONSIDERED INCOMPLETE)	DATE STAMP/FSO NAME/COMMENT FIELD
PM-9 & PM-17	PM CLOSURE	DATE STAMP/FSO NAME/COMMENT FIELD

**Table A1: Information to be recorded in FSOMS (refer to Appendix 1)**

**NOTE**

Full reference is defined as follows: WFSO to keep a copy of the correspondence (e-mail, letter or message) on file; FSOMS to include reference details with a short description (in free text field)

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**APPENDIX 1 – PM MANAGEMENT PROCESS DIAGRAM**

