Number: SN-2022/01

Issued: 10 January 2022

SAFETY NOTICE

SUBJECT:

Guidance for Air Operators in Utilizing Safety Trend Information to Enhance Flight Crew Proficiency through Performance Based Training

GENERAL: Safety Notices (SNs) are issued by the Civil Aviation Authority – Macao, China to convey advisory information to Macao aviation entities to enhance safety. SNs contain safety-related recommendations, guidance and/or industrial best practices to specific subjects which may or may not have been addressed by established requirements and regulations.

RELATED REGULATIONS: AC/OPS/025 – Training and Testing Requirements for Flight Crew Member and Flight Operations Officer
AC/OPS/034 – Flight Data Analysis Programme

APPLICABILITY: This SN applies to all Macao air operators.

CANCELLATION: This SN is the first SN issued on this subject.

REFERENCES: The following material was referred to for the development of this SN:

- ICAO Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC) endorsed safety tools – Guidance Material on Flight Crew Proficiency

1. Introduction

1.1 This Safety Notice is issued to provide air operators guidance on the integration of Safety Management System (SMS) processes for hazard identification and risk management with operational decision making in utilizing safety trend information in the development and implementation of performance based training to enhance flight crew proficiency in particular to address the regional High-Risk Category (HRC) of Loss of Control In-flight (LOC-I) as identified in the APAC Regional Aviation Safety Plan (AP-RASP).

2. Background

2.1 LOC-I is the leading cause of aircraft fatalities worldwide. Aside from their frequency of occurrence, accidents resulting from loss of aircraft control seize the public's attention by yielding a large number of fatalities in a single event.

2.2 The ICAO Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC) endorsed a safety tool which provide guidance for air operators to develop and implement performance based flight crew training program using their own aggregate information from SMS, such as Flight Data Analysis Program (FDAP), safety reports, audits and other non-punitive safety reporting program in enhancing flight crew proficiency aimed at mitigating safety risks, incidents or accidents related to LOC-I.

3. Guidance on utilizing safety trend information in the development and implementation of performance based training program

3.1 STEP 1: Develop policy and procedure in regard to effective implementation of performance based training.

Development of policy and procedures on the use of FDA and other non-punitive safety data for the purpose of enhancing flight crew proficiency should be carried out appropriately.

3.2 STEP 2: Ensure that the safety practitioner responsible for the management of aggregate data for the purpose of providing performance based training information is adequately trained and qualified.

The operator shall set the criteria for selection of the personnel required to lead and manage the program.

The safety personnel should be trained with respect to analyzing data and providing recommendation for the training department based on the information gathered from FDA and other aggregate safety reporting.

3.3 STEP 3: Gather data from all safety programs and audits with regard to LOC-I.

This can be achieved by having a systematic data acquisition and monitoring program established through Flight Data Monitoring (FDM), air safety reports, audit reports and other means of acquiring trend data, including the use of integrated safety database.

<u>Integrated safety database</u>

In addition to having a basic database to capture and archive safety information is essential for the conduct of safety performance analysis on LOC-I events, greater benefit can be realized by linking the existing safety database within the organisation such as database for air safety reports, FDA, audit reports, investigation findings, etc., in order to provide integrated analysis of events or lead indicators to incidents or accidents.

This integration of all available sources of safety data provides the organisation viable information on the overall safety health of the operation, including prevention of LOC-I events.

For example, failure to extend landing flaps during an approach may be captured by:

a. Air safety report submitted by the flight crew

b. FDA event captured

c. Engineering report

In this instance, the crew report provides the context, the FDA event provides the quantitative description, and the engineering report provides in depth technical information of the defect and the rectification performed.

Alternatively, safety information can be obtained from individual department and resources in the absence of an integrated safety database.

3.4 STEP 4: Develop flight safety analysis program focusing on identification of hazards related to LOC-I events.

A primary function of flight safety analysis program is hazard identification supported by data analysis capability, which is an element of safety risk management component of SMS.

Hazard identification and risk management is a prerequisite to establish a performance based training. Information gathered from safety database is evaluated to identify hazards and its associated risks related to LOC-I events, particularly those hazards that are deemed to be contributory factors to LOC-I incidents or accidents. Among the LOC-I indicators that are available from Flight Data Analysis Program (FDAP) include: high pitch rate, dual input, thrust asymmetry, excessive bank angle, early configuration change, flight control malfunction, windshear and others.

Following identification of hazard, the next step is to perform a risk assessment for each of the hazards using a risk matrix in relation to the likelihood and severity of the consequence of the risk related. Typically, a 5 x 5 risk matrix is used (as shown below), although there are several variations that are available such as 4 x 4 and 3 x 3 matrix. The matrix selected will depend upon the size and complexity of the organisation and the risks being assessed.

Likelihood ↑ / Impact →	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Diagram 1: Risk Matrix

Note: Information on the method of performing risk assessment is covered extensively in ICAO Document 9859.

Determination of the level of risk provides the air operator guidance with regard to the allocation of resources and the priority accorded to eliminate or mitigate the risks identified.

A mitigation is an action taken to reduce the risk of exposure to a hazard. Based on system safety science, once a hazard is identified the priority of addressing the hazard should be:

a. Hazard elimination (intrinsic safety)

b. Hazard reduction

c. Hazard control

d. Damage reduction

Hazard and risk management will require a pragmatic approach and will require conducting realistic or credible and plausible appraisals of the hazards and associated risks faced by the air operator's operational activities (See diagram below). A common approach may be applied but the hazards, risks and mitigation may vary due to the operating equipment, type of operation and operating environment including supporting infrastructure.

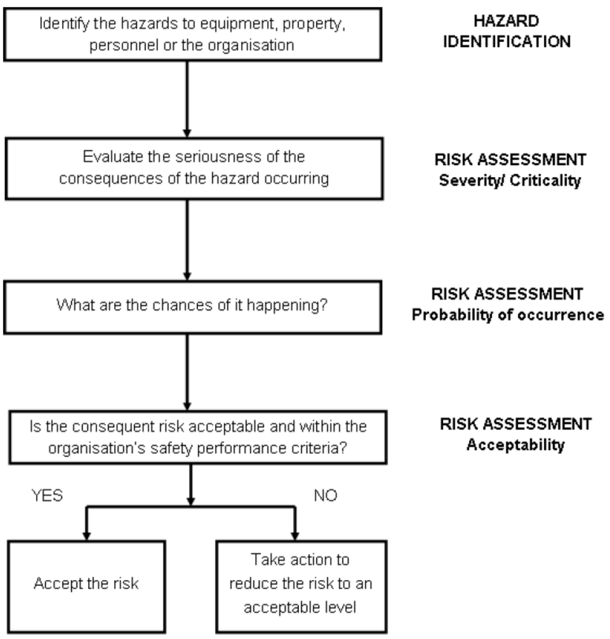

Diagram 2: Risk Assessment Process

For aircraft loss of control, hazard elimination is a desirable but difficult-to-reach goal, given the nature of performance demands in atmospheric flight. Thus, research should focus on hazard reduction, hazard control, and damage reduction.

Prevention of loss of control events are more important strategies when compared to recovery based mitigation, however, development of recovery-based mitigations is also required in order to ensure complete coverage when "breading the chain" of events in a loss of control scenario.

Onboard systems that eliminate, or protect the aircraft from entering a loss of control scenario are most effective. Avoidance and detection of loss of control events should not be limited to real-time, onboard systems, but should include data mining of incident reports, accidents reports, and flight operations quality assurance data to identify trends and conditions that lead to loss of control so that the precursors may be eliminated or minimized. Continued diligence by operational, research, and regulatory organisations is required in order to improve aviation safety record.

Another technique commonly employed by air operators in risk assessment is the Bowtie methodology. It is described as a risk evaluation method that can be used to analyze and demonstrate causal relationships in high risk scenarios. Taking its name after the shape of diagram which looks like a man's bowtie, the methodology serves to provide a visual summary of all plausible accidents scenarios that could exist around a certain hazard, while it identifies the control measures that are put in place to mitigate the consequence of the hazard. (See diagram below)

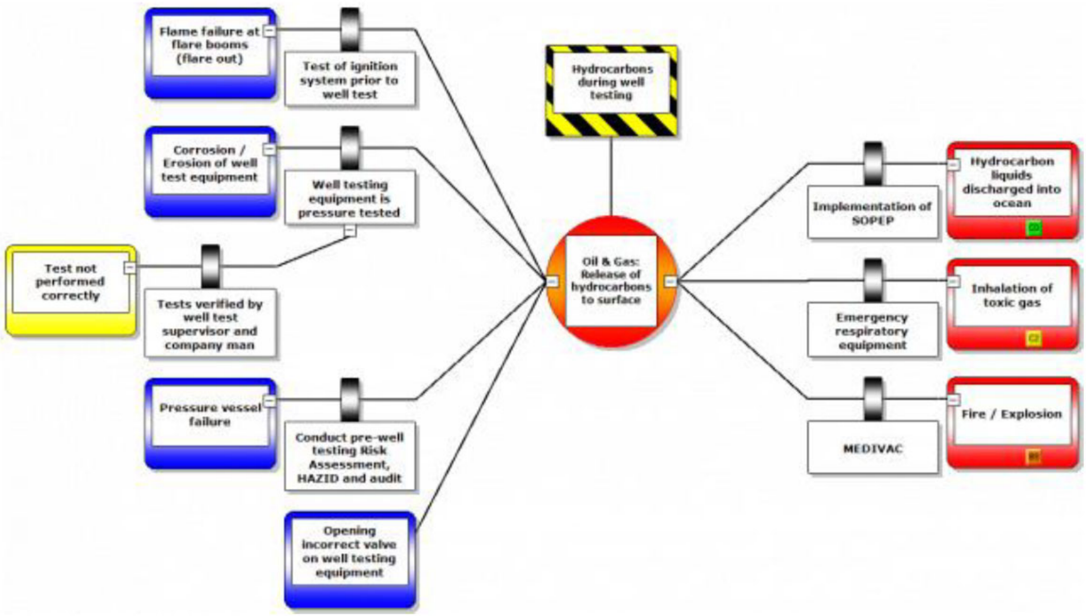

Diagram 3: Bow Tie Sample

The bowtie application may be integrated with organisation's management system to provide an overview of the activities that keeps the control working and the persons responsible over the controls.

Ultimately, the risk management system established within the organisation must be capable of identifying and addressing the current operational and systemic issues, as well as detecting any emerging risks that would affect safety of operations.

3.5 STEP 5: Development of Safety Performance Indicator (SPI) and setting of Safety Performance Target (SPT) by air operator.

Performance based safety management is dependent on having safety indicators that are monitored using basic quantitative data trending tools that generate graphs and charts that incorporate alerts/targets. The safety indicators consist of high (accidents and serious incidents) and low consequence events as hazard reports, audits findings, FDA, safety observations and others. Low consequence events are sometimes termed 'proactive/predictive' indicators.

SPT which define long term safety performance objectives, are expressed in numerical terms (absolute or relative value) and must be concrete, measurable, acceptable, reliable, relevant and contain timeline (milestone) for completion. When setting the targets, consideration should be given into factors such as applicable level of safety risk, the cost and benefits attached to the expected safety improvement, and achievability of the set target, with reference to recent historical performance of that particular safety indicator, industry standards, regulatory requirement as well as expert opinion.

A corresponding alert level is identified for each SPI, quantifying the acceptable and unacceptable performance threshold during a specific monitoring period. The use of objective data-based criteria for setting alert levels is essential to facilitate consistent trending or benchmark analysis.

In general, the use of population standard deviation (STDEVP) provides a basic objective method of setting alert criteria, the method derives the standard deviation (SD) value based on the preceding historical data points of a given safety indicator. This SD value plus the average (mean) value of the historical data set forms the basic alert value for the next monitoring period. The SD principal (a basic MS Excel function) sets the alert level criteria based on the actual historical performance of the given indicator, including its volatility (data point fluctuations). Guidance on SPI, SPT and alert level setting using SD criteria is provided in ICAO Doc 9859 Safety Management Manual.

Sample of Safety Performance Indicator and Target:

Risk Ref	Safety Performance Indicator	Source	Target	YTD 2016 Performance	Rating	B/Threshold (1)	Threshold (2)	On Target (3)	Exceeding (4)	Outstanding (5)
A-02	**Loss OF Control In-Fliight Risk**									
	Unstable Approach	FDA	4-6	10	1	>9	7-9	4-6	2-3	1
	Engine (Turbine/Turboprop) Failure	ASR	2-3	0	5	>5	4-5	2-3	1	0
	Flight Control Malfunction	ASR	2-3	1	4	>5	4-5	2-3	1	0
	Pressurization malfunction	ASR	2-3	2	3	>5	4-5	2-3	1	0
	Windshear	ASR	5-6	7	2	>8	7-8	5-6	3-4	<3

Diagram 4: Safety Performance Indicator and Target

3.6 STEP 6: Establish and maintain a flight data analysis program (FDAP) as part of its Safety Management System, in addition to maintaining an effective open reporting system.

A flight data analysis program shall be non-punitive and contain adequate safeguards to protect the source(s) of the data. In addition, having an open reporting initiatives supported by "Just Culture" principals, is aimed at identifying and managing potentials hazards and risks associated with on-going aviation activities. They serve as a useful tool to ensure sufficient information is available to make appropriate decisions and operational controls with regard to managing emerging safety threats. This is achieved by offering the ability to track and evaluate flight operations trends, identify risk precursors, and taking appropriate remedial action.

The parameters analyzed on FDA framework should reflect elements that could contribute towards of LOC-I event.

The de-identified data is processed in accordance with the flow chart shown below:

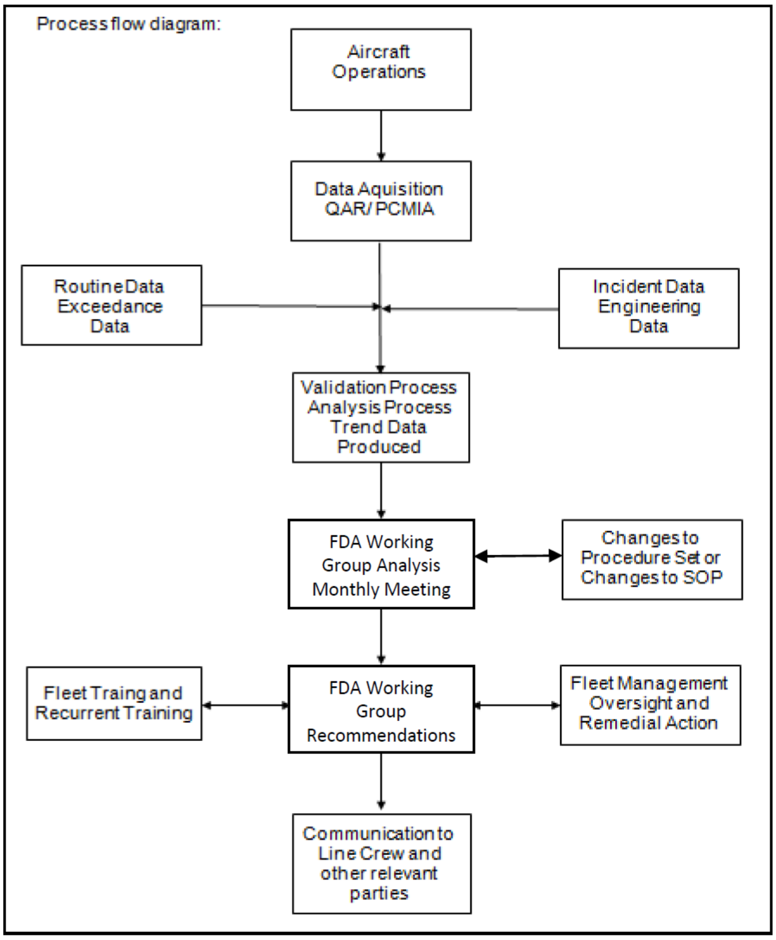

Diagram 5: FDM Process Flow

3.7 STEP 7: Analyze collected data to identify events leading to an LOC-I.

Based on the analysis of data collected, lead indicators to LOC-I event could be identified from the list of probable cause outlined (human, system and environmentally induced), FDA outputs, safety/audit reports, investigation findings, and others, which may be translated into Safety Performance Indicator (SPI). The corresponding Safety Performance Target (SPT) value can be developed based on quantification of its potential outcome, taking into consideration the risk factors identified for each of the elements. These include applying various combinations of high/low probability against severity of occurrence, as prescribed by the Safety Risk Assessment Matrix, to formulate the appropriate target in relation to past performance, industry standards or regulatory requirement. This provides the basis for the Operator to develop/design specific LOC-I training enhancements.

An alert level can be set prior to reaching the target limit, in order to provide early notification to training department of the imminent risks and to initiate enhancement program to improve on related flight crew proficiency.

This analysis of LOC-I related safety data, identification of SPI and setting of SPT and the corresponding alerts should be undertaken by the SMS integrated working group who will be the subject matter experts in the related field.

3.8 STEP 8: Develop and design LOC-I enhancement training specifically in preventing LOC-I events, identification of impending LOC-I and recovery.

From the trend analysis and safety reports, areas of greater safety concern can be identified and the training department will be notified to develop a safety action plan to address the impending unsafe concerns identified. The training department will then notify the working group of the action plans, and on agreement between both parties, implement the training program which shall be accomplished within a period of 6 months (proficiency check intervals).

Simultaneously, the training department shall incorporate such specific training curricula in the training syllabus and the relevant operations manual in concurrence with the manufacturer. Emphasis must also be given in developing training program in the prevention of LOC-I incidents through a more effective flight path monitoring function.

3.9 STEP 9: Deliver the enhanced LOC-I training through both simulator training and appropriate literature.

Once established, the training curricula will be incorporated in the Operations Manual approved by the regulator, which will then be referenced for the proper conduct of the training and qualification. The delivery method shall include the use of simulator, computer based training (CBT) or literatures highlighting the safety event and the follow up action established. Appropriate revisions and syllabus enhancement may be referenced from lessons learned both internally and from other operators around the globe.

The simulator used in the conduct of LOC-I training must be suitably programmed and capable of simulating possible scenarios or conditions that can lead to this specific event. In this respect, consultation with the aircraft and simulator manufacturer is crucial in the development of appropriate simulator training program, whilst ensuring that the flight instructors are suitably trained and qualified to conduct the relevant training.

The operator may incorporate this into Evidence Based Training (EBT) Program.

3.10 STEP 10: Monitor the effectiveness of the training program through quality assurance program.

Internal audits and safety assurance program should be established to monitor the effectiveness of the performance based training in achieving the required safety objective. Operators should develop or propose specific LOC-I training enhancement performance indicator to facilitate effective assessment of the training program.

3.11 STEP 11: Review and modify the training program to meet overall safety performance.

In the event that a short fall in training and safety performance in the areas relating to LOC-I is evident, it is necessary to conduct an immediate review of the process involved to ascertain whether the prescribed safety action plan is indeed effective and appropriate to realize the desired outcome. If this cannot be accomplished, a new or updated follow up must be executed and subsequently monitored for any deviation from the required target.

Refer to Appendix 1 for the data integration and safety performance enhancement process flow chart.

4. Recommended Actions

4.1 Air operators are encouraged to note the information contained in this Safety Notice and review their policies, procedures and training to reflect the safety issues contained in this SN.

- End -

APPENDIX 1

Data Integration and Safety Performance Enhancement Process