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Civil Aviation Authority of Singapore

Advisory Circular

STANDARD OPERATING PROCEDURES FOR FLIGHT CREW MEMBERS

GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 3C of the Air Navigation Act (Cap. 6) (ANA), to demonstrate compliance with a statutory requirement. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This AC provides to demonstrate compliance with, and information related to, the requirements on the development and implementation of Standard Operating Procedures for flight crew members.

APPLICABILITY

This AC is applicable to an AOC holder operating an aeroplane in accordance with ANR-121.

RELATED REGULATIONS

This AC relates specifically to Regulation 21 and the Fourth Schedule of ANR-121.

RELATED ADVISORY CIRCULARS

- AC 121-2-1 Guidance on Operational Procedures for ANR-121 Operations
- AC 121-12-2 Operations Manual for Operations under ANR-121

CANCELLATION
This AC supersedes AC AOC-4.

EFFECTIVE DATE
This AC is effective from 1 October 2018.

OTHER REFERENCES
- ICAO Doc 8168 PANS-OPS
- COSCAP-SEA CSEA-002A

1 INTRODUCTION

The International Civil Aviation Organisation (ICAO) has identified deficiencies in standard operating procedures (SOP) as contributing causal factors in aviation accidents. Among the most commonly cited deficiencies involving flight crew has been their non-compliance with established procedures and the non-existence of established procedures in some manuals used by flight crew.

In recognition of the importance of SOPs for safe flight operations, ICAO amended both Annex 6 Part 1 and PANS OPS Document 8168, Vol. I so as to require that SOPs for each phase of flight be contained in the operations manual used by pilots.

Many aviation safety organisations have also concluded that AOC holders perform at higher levels of safety when they establish and their crew adhere to a well-developed SOPs.

Effective crew coordination and crew performance are two central concepts of crew resource management (CRM) which depend upon the crew having a shared mental model of each task. That mental model, in turn, is founded on adherence to a well-developed SOPs.

It is a requirement in the Fourth Schedule of ANR-121 that SOPs for each phase of flight be contained in the operations manual.

2 SCOPE

This AC provides guidance for the AOC holder in the development and implementation of SOPs for flight crew members. It does not list every important SOP topic nor dictates exactly how each topic should be addressed by the AOC holder. It presents the background, basic concepts, and philosophy with respect to SOPs. It emphasises that SOPs should be clear, comprehensive, and readily available in the manuals used by flight crew members.

In this regard, an SOP Template is provided in **Appendix A** which consolidates common topics that are considered important to be addressed as SOPs in AOC holder's training programmes and in the manuals used by flight crew members.

In practice, each AOC holder's manuals and training programmes are unique. The AOC holder may omit topics shown in the template or add other topics as and when the AOC holder deems applicable.

3 THE PURPOSE OF AN SOP

To achieve consistently safe flight operations through adherence to a well-developed SOPs, the SOPs must be clear, comprehensive, and readily available to the flight crew members.

4 APPLYING THE SOP TEMPLATE AND OTHER APPENDICES

Generally, each SOP topic identified in the template (see **Appendix A**) is important and it should be addressed in some manner by the AOC holder as applicable. A Stabilised Approach SOP (**Appendix B**) is a particularly important SOP. Other

important SOPs, such as those associated with special operating authority or with new technology, are not shown in the template but they should be addressed as well where applicable.

Because each AOC holder's operation is unique, developing the specific manner in which SOPs are addressed is the task of the AOC holder. Topics expanded and illustrated in the Appendices are for example only, and they represent renditions of SOPs known to be effective. No requirement is implied or intended to change existing SOPs based solely on these examples. An SOP topic shown in the Appendices may be addressed in detail, including text and diagrams, or in very simple terms. For example, an SOP may be addressed in a simple statement such as: "xxx Airline does not conduct Category III approaches."

5 KEY FEATURES OF AN EFFECTIVE SOP

The implementation of any procedure as an SOP would be most effective if:

(a) The procedure is appropriate to the situation;

(b) The procedure is practical to use;

(c) Crew members understand the reasons for the procedure;

(d) Pilot Flying (PF), Pilot Monitoring (PM), and Flight Engineer duties are clearly delineated;

(e) Effective training is conducted; and

(f) The attitudes shown by instructors, check pilots, and managers all reinforce the need for the procedure.

If all the above elements are not consistently implemented, flight crew may easily become participants in an undesirable double standard condoned by instructors, check pilots, and managers. Flight crew may end up doing things one way to satisfy training requirements and check rides, but doing them another way in "real life" during line operations. When a double standard does appear in this way, it should be considered a red flag that a published SOP may not be practical or effective for some reason. That SOP should be reviewed and perhaps changed.

6 THE IMPORTANCE OF UNDERSTANDING THE REASONS FOR ANY SOP

Effective Feedback. When flight crew members understand the underlying reasons for any SOP, they are better prepared and more eager to offer effective feedback for improvements. The AOC holder, in turn, benefits from more competent feedback in revising existing SOPs and in developing new SOPs. Those benefits include safety, efficiency, and employee morale.

Troubleshooting. When flight crew members understand the underlying reasons for any SOP, they are generally better prepared to handle a related in-flight problem that may not be explicitly or completely addressed in their operating manuals.

7 COLLABORATING TO DEVELOP AN EFFECTIVE SOP

In general, effective SOPs are the product of healthy collaboration among managers and flight operations personnel, including flight crews. A safety culture promoting continuous feedback from flight crews and others, and continuous revision by the collaborators distinguish effective SOPs of AOC holders varying in sizes and ages. When introducing a new aircraft fleet, or retiring one aircraft fleet for another, the AOC holder must be especially diligent in developing or reviewing SOPs. Collaborators with applicable experience may be more difficult to gather in those instances.

For a start-up AOC holder, this AC and its Appendices would be especially valuable in developing SOPs. The AOC holder should pay close attention to the approved airplane flight manual (AFM), to AFM revisions and operations bulletins issued by the manufacturer. Desirable partners in the collaboration would certainly include representatives of the aircraft manufacturer, pilots having previous experience with the aircraft or with the kind of operations planned by the AOC holder, and the Authority. It is especially important for a new AOC holder to maintain a periodic review process that includes line flight crews. Together, managers and flight crews are able to review the effectiveness of SOPs and reach valid conclusions for revisions. The review process will be meaningful and effective when managers promote prompt implementation of revisions to SOPs when necessary.

An existing AOC holder introducing a new aircraft fleet should also collaborate using the best resources available, including the AFM and operations bulletins. History has proven that representatives of the aircraft manufacturer, managers, check pilots, instructors, and line pilots work well together as a team to develop effective SOPs. A trial period might be implemented, followed by feedback and revision, in which SOPs are improved. By being part of an iterative process for changes in SOPs, the end user, the flight crew member, is generally inclined to accept the validity of changes and to implement them readily.

Long-established AOC holders should be careful not to assume too readily that they can operate an aircraft recently added to the fleet in the same, standard way as older types or models.

Managers, check pilots, and instructors should work together and utilise the best resources available, including the AFM and operations bulletins to ensure that SOPs developed or adapted for a new aircraft are in fact effective for that aircraft, and are not inappropriate carryovers.

8 SUMMARY

Safety in commercial aviation continues to depend on good crew performance. Good crew performance, in turn, is founded on a well-developed SOPs that are clear, comprehensive, and readily available to the flight crew. This AC provides an SOP template and many other useful references in developing SOPs. Development of SOPs is most effective when the resources available are actively optimised through the partnership of all relevant parties. Thereafter, effective SOPs should be continually reviewed and renewed to accommodate any subsequent changes in the industry.

9 NOTES ON APPENDICES

The following appendices contain examples of SOPs that are identical to or similar to some SOPs currently in use. Those examples do not represent a rigid CAAS view of best practices, which may vary among fleets and operators, and are subject to change over time.

Some of the examples may be readily adapted to an AOC holder's flight crew training and operating manuals for various aircraft fleets.

- Appendix A: Standard Operating Procedures (SOP) Template.
- Appendix B: Stabilised Approach - Concept and Terms.
- Appendix C: ATC Communications and Altitude Awareness.
- Appendix D: Crew Briefings – Pilot and Cabin Crew.
- Appendix E: Crew Monitoring and Cross-Checking.

APPENDIX A STANDARD OPERATING PROCEDURES (SOP) TEMPLATE

A manual or section in a manual serving as the flight crew's guide to standard operating procedures (SOPs) may double as a training guide. The content should be clear and comprehensive, without necessarily being lengthy. No template could include every topic that might apply unless it was constantly revised. Many topics involving special operating authority or new technology are absent from this template, among them ETOPS, PRM, SMGS, RNP, and many others. The following are nevertheless viewed by industry and Authority alike as examples of topics that constitute a useful template for developing comprehensive and effective SOPs:

Pilot-in-command's authority

Use of automation

The AOC holder's automation philosophy
Specific guidance in selection of appropriate levels of automation
Autopilot/flight director mode control inputs
Flight management systems inputs

Checklist philosophy:

Policies and procedures - (Who calls for; who reads; who does)
Checklist interruptions
Checklist ambiguity
Checklist couplings
Checklist training
Format and terminology

Type of checklist

Challenge-Do-Verify
Do-Verify
Walk-arounds

Checklists

Safety check - power on
Originating/receiving
Before start
After start
Before taxi
Before take-off
After take-off
Climb check
Cruise check
Before landing
Landing
After landing
Parking and securing
Emergency procedures
Non-normal/abnormal procedures

Report times

Check in/show up
On flight deck
Checklist accomplishment

Communications

Who handles radios
Primary language used with ATC and On the flight deck
Keeping both pilots in the loop
Company radio procedures
Flight deck/cabin signals
Cabin/flight deck signals

Briefings

CFIT risk considerations
Special airport qualifications
Temperature corrections
Before take off
Descent/approach/missed approach
Approach briefing (generally done prior to beginning of descent)
Flight deck access
On ground/in flight
Jumpseat/observer seat
Access signals, keys

Flight deck discipline

Sterile cockpit
Maintaining outside vigilance
Monitoring/Cross checking
Transfer of control
Additional duties
Flight kits
Headsets/speakers
Boom mikes/handsets
Maps/approach charts
Meals

Altitude awareness

Altimeter settings
Transition level
Callouts (verification of)
Minimum safe altitudes (MSA)
Temperature corrections
Monitoring during last 1000 feet altitude change

Take-off

PF and /PM duties and responsibilities
Briefing, IFR/VFR
Reduced power procedures
Tailwind, runway clutter
Intersections/land and hold short procedures (LAHSO)

Maintenance procedures

Logbooks/previous write-ups
Open write-ups
Notification to maintenance of write-ups
Minimum equipment list (MEL)
Where it is accessible
Configuration Deviation List (CDL)
Crew coordination in ground de-icing

Flight plans/dispatch procedures

VFR/IFR
Icing considerations
Fuel loads
Weather package
Where weather package is available
Departure procedure climb gradient analysis

Boarding passengers/cargo

Carry-on baggage
Exit row seating
Hazardous materials
Prisoners/escorted persons
Guns onboard
Head-count/load

Pushback/ towforward

Taxiing

All engines running
Less than all engines running
On ice or snow or heavy rain
Low visibility
Prevention of runway incursion

Crew resource management (CRM)

Crew briefings : Flight crew; Cabin Crew

Mass & balance/cargo loading

Who is responsible for loading cargo, and securing cargo
Who prepares the mass & balance data form; who checks it
Signed copy to crew

Flight deck/cabin crew interchange

Boarding
Ready to taxi
Prior to take-off/landing

Noise abatement procedures
Special departure procedures
Use of Flight directors
Callouts
Clean up

Flap settings

Normal
Non-standard and reason
Crosswind
Close-in turns

Climb

Speeds
Configuration
Compliance with climb gradient required in departure procedure
Appropriate cold temperature corrections

Cruise altitude selection

Speeds/weights

Position reports/ pilot weather reports

ATC - including pilot report of hazards such as icing, thunderstorms and turbulence, windshear, presence of bird hazard, volcanic ash
Company reports

Holding procedures

Procedures for diversion to alternate

Descents
- Planning and discussing prior to beginning of descent point
- Risk assessment and briefing
- Use of speed brakes
- Flaps/gear extension
- Icing considerations
- Convective activity
- Ground proximity warning system (GPWS and TAWs)
- Escape manoeuvre
- TCAS

Windshear
- Avoidance of likely encounters
- Recognition
- Recovery / escape manoeuvre

Approach philosophy
- Monitoring during approaches
- Precision approaches preferred
- Stabilised approach and limits
- Use of navigation aids
- Flight management system (FMS) /autopilot use and when to discontinue use
- Approach gates
- Use of radio altimeter
- Individual approach type
- All types, including engine-out
- Go-around: Plan to go around; change plan to land when visual

For each type of approach Profile
- Aircraft configuration for conditions:
  - Visual approach
  - Low Visibility
  - Contaminated runway
- Flap/gear extension
- Auto spoiler and auto brake procedures - Actions and Callouts

Go-around/missed approach
- When stabilised approach gates are missed
- Procedure – Actions and callouts
- Clean-up profile

Landing
- Actions and callouts during landing
- Crosswind
- Rejected Landing
- Actions and Callouts during rollout
- Transfer of control after first officer landing

APPENDIX B STABILISED APPROACH: CONCEPTS AND TERMS

Stabilised Approach
A stabilised approach is one of the key features of safe approaches and landings in air operations, especially those involving transport category aircraft.

A stabilised approach is characterised by a **constant-angle, constant-rate of descent** approach profile ending near the touchdown point, where the landing manoeuvre begins. A stabilised approach is the safest profile in all but special cases, in which another profile may be required by unusual conditions.

Note: All appropriate briefings and checklists should be accomplished before 1000' height above threshold (HAT) in instrument meteorological conditions (IMC), and before 500' HAT in visual meteorological conditions (VMC).

Flight should be **stabilised by 1000'** height above threshold (HAT) in instrument meteorological conditions (IMC), and by 500' HAT in visual meteorological conditions (VMC). An approach that becomes destabilised below the altitudes shown here would require an immediate go-around.

An approach is stabilised when all of the following criteria are maintained from 1000' HAT (or 500' HAT in VMC) to landing in the touchdown zone:

- The aircraft is on the correct[1] track.
- The aircraft is in the proper landing configuration.
- After glide path intercept, or after the Final Approach Fix (FAF), or after the derived fly-off point (per approach charts) the pilot flying requires no more than normal bracketing corrections[2] to maintain the correct track and desired profile (3º descent angle, nominal) to landing within the touchdown zone. Level-off below 1000' HAT is not recommended.
- The aircraft speed is within the acceptable range specified in the approved operating manual used by the pilot.
- The rate of descent is no greater than 1000 fpm.

Note 1: If an expected rate of descent greater than 1000 fpm is planned, a special approach briefing should be performed.

Note 2: If an unexpected, sustained rate of descent greater than 1000 fpm is encountered during the approach, a missed approach should be performed. A second approach may be attempted after a special approach briefing, if conditions permit.

[1] A correct track is one in which the correct localiser, radial, or other track guidance has been set, tuned, and identified, and is being followed by the pilot.
[2] Normal bracketing corrections relate to bank angle, rate of descent, and power management. Recommended ranges in the operating limitations of the approved airplane flight manual, which may be more restrictive, must be observed.

Vertical Guidance
Vertical guidance may be provided to the pilot by way of an electronic glideslope, a computed descent path displayed on the pilot's navigation display, or other electronic means. On approaches for which no vertical guidance is provided, the flight crew should plan, execute, and monitor the approach with special care, taking into account traffic and wind conditions.

To assure vertical clearance and situation awareness, the pilot not flying should announce crossing altitudes as published fixes and skip other points selected by the flight crew. The pilot flying should promptly adjust descent angle as appropriate. A constant-angle, constant-rate descent profile ending at the touchdown point is the safest profile for all normal approaches.

Visual contact. Upon establishing visual contact with the runway or appropriate runway lights or markings, the pilot should be able to continue to a safe landing using normal bracketing corrections, or otherwise, perform a missed approach.

No visual contact. The AOC holder may develop procedures involving an approved, standard MDA buffer altitude or other approved procedures to assure that descent below MDA does not occur during the missed approach. If no visual contact is established upon approaching MDA or an approved MDA buffer altitude, or if the missed approach point is reached, the pilot should perform the published missed approach procedure. Below 1000' HAT, levelling off at MDA (or at some height above MDA) is not recommended, and a missed approach should be performed.

Course Guidance
Specific types of approaches are stabilised if they also fulfil the following:

- Instrument Landing Systems (ILS) must be flown within +/- one (1) dot of the glide slope and localiser;
- Category II or Category III ILS approach must be flown within the expanded localiser band;
- During a circling approach, the wings should be level on final when the aircraft reaches 300 feet above the airport elevation; and
- Unique approach procedures for abnormal conditions requiring a deviation from the above elements of a stabilised approach require a special briefing.

Bank Angle
Maximum bank angle permissible during approach is specified in the approved operating manual, and is generally not more than 30º; the maximum bank angle permissible during landing may be considerably less than 30º, as specified in that manual.

Rate of Descent
The rate of descent should be within ±300 fpm of the target rate.

Power Management
The permissible power range is specified in the approved operating manual.

Overshoots
Normal bracketing corrections occasionally involve momentary overshoots made necessary by atmospheric conditions. Such overshoots are acceptable. Frequent or sustained overshoots caused by poor pilot technique are not normal bracketing corrections.

APPENDIX C EXAMPLES OF ATC COMMUNICATIONS AND ALTITUDE AWARENESS

ATC Communications

SOPs should state who (PF, /PM, FE/SO) handles the radios for each phase of flight and will read back to the air traffic controller the following ATC clearances and instructions and air safety related information which are transmitted by voice:

(a) ATC route clearances;

(b) Clearances and instructions to enter, land on, takeoff on, hold short of, cross and backtrack on any runway;

(c) runway-in-use, altimeter settings, SSR codes, level instructions, heading and speed instructions and, whether issued by the controller or contained in ATIS broadcasts, transition levels.

Other clearances or instructions including, conditional clearances, should be read back or acknowledged in a manner that clearly indicates that the message has been understood and will be complied with.

PF should make input to aircraft/autopilot and/or verbally state clearances while /PM confirms that the input is what he/she read back to ATC. Any confusion in the flight deck should be clarified immediately by requesting ATC confirmation.

If any crew member is off the flight deck, all ATC instructions should be briefed upon his/her return, or written down and then passed to that crew member upon return. Similarly, if a crew member is off the ATC frequency (e.g., when making a PA announcement or when talking on company frequency), he/she should be updated.

Company policy should also address the use of speakers, headsets, boom mike and/or hand-held mikes during various stages of flight. Company personnel should comply with all standard ATC phraseology as referenced in ICAO PAN OPS, Annex 11 and PANS–ATM (Air Traffic Management Document 4444).

Altitude Awareness

SOPs should state the company policy on confirming assigned altitude.

Examples:

(a) The /PM acknowledges ATC altitude clearance. If the aircraft is on autopilot, the PF should make an input into the autopilot/altitude alerter. PF points to the input while stating the assigned altitude as he/she understands it. The /PM then points to the input stating aloud what he/she understands the ATC clearance to be confirming that the input and clearance match.

(b) If the aircraft is being hand-flown by the PF, the PM makes the input into the Altitude Alerter, then points to the input and states clearance. PF then states aloud what he/she understands the ATC clearance to be confirming that the alerter and clearance match.

(c) If there is no altitude alerter in the aircraft, then both pilots should write down the clearance to confirm that they have the same altitude and then cross off the previously assigned altitude.

APPENDIX D EXAMPLES OF CREW BRIEFINGS

Pilot Briefing

The purpose of the pilot briefing is to enhance communications on the flight deck and to promote effective teamwork. Each crew member is expected to perform as an integral part of the team. The briefing should establish a mutual understanding of the specific factors appropriate for the flight.

A pilot briefing will be given prior to starting engines for the first flight of the day and subsequent flights, if applicable. The pilot-in-command determines the length and detail of the briefing. Factors to consider include:

- Experience level of the pilots
- Special MEL procedures as a result of inoperative components
- Specific airfield requirements /Altimeter setting
- Use of delayed engine start and/or engine out taxi procedures

When personnel occupy the extra crew seat(s), ensure that they understand the use of oxygen/ interphone operations and emergency exits, and sterile flight deck procedures.

Scope of Takeoff Briefing

A Takeoff Briefing will be given **prior** to takeoff. Factors to consider include:

- Takeoff weather conditions
- Runway surface conditions
- NOTAMS
- Departure review
- Obstructions and high terrain
- Closeout mass and balance message/takeoff numbers
- Critical conditions affecting the GO/NO-GO decision (e.g., gross weight limited takeoff, wet or slippery runway, crosswind, aircraft malfunctions)
- Birdstrike potential, if applicable

Scope of Descent Briefing

A Descent Briefing will be given prior to descent into destination. Factors to consider include:

- Landing weather conditions
- Runway surface conditions
- NOTAMS
- Expected Arrival Clearance
- Review of airport and approach charts
- Obstructions and high terrain – CFIT/ALAR measures
- Landing configuration and speeds
- Missed Approach procedures
- Birdstrike potential, if applicable

Cabin Crew Briefing

The purpose of the cabin crew briefing is to develop a team concept between the flight deck and cabin crew. An ideally developed team must share knowledge relating to flight operations, review individual responsibilities, share personal concerns, and have a clear understanding of safety and security expectations.

Upon flight origination or whenever a crew change occurs, the pilot-in-command will conduct a verbal briefing, preferably with all the cabin crew. However, preflight duties, passenger boarding, rescheduling, etc. may make it impractical to brief the entire cabin crew complement. Regardless of time constraints, the pilot-in-command should brief the lead cabin crew. The briefing should be supplemented with a completed Cabin Crew Briefing Form. The briefing should cover the following items:

- Weather affecting the flight (e.g., turbulence – including appropriate code levels, thunderstorms, weather near minimums, etc.). Provide the time when the weather may be encountered rather than a distance or location (e.g., “Heavy turbulence can be expected approximately one hour after takeoff.”).

- Delays, unusual operations, non-routine operations (e.g., maintenance delays, ATC delays, re-routes, etc.).

- Shorter than normal taxi time or flight time which may affect pre-flight announcements or cabin service.

- Any other items that may affect the flight operation or in-flight service such as catering, fuel stops, armed guards, code-words, etc.

- A review of the sterile flight deck policy, responsibility for PA announcements whenever the Fasten Seat Belt sign is turned on/off during cruise, emergency evacuation commands, or any other items appropriate to the flight.

- Logbook discrepancies that may affect cabin crew responsibilities or passenger comfort (e.g., coffee maker inoperative, broken seat backs, manual pressurisation, etc.).

During the briefing, the pilot-in-command should solicit feedback for operational concerns. He/she should also solicit feedback for information which may affect expected team roles. Each crew member should be empowered to take a leadership role in ensuring all crew members are made aware of any potential item that might affect the flight operation.

The lead cabin crew should inform the pilot-in-command of any inoperative equipment and the number of cabin crew on board. The pilot-in-command should inform the lead cabin crew when there are significant changes to the operation of the flight after the briefing has been conducted.

Note: The above examples are not exhaustive nor are they the only types of briefings to be conducted. Each AOC holder is to publish its own SOP/ Crew Briefings to best meet its operating requirements.

APPENDIX E CREW MONITORING AND CROSS-CHECKING

Background

Several studies of crew performance, incidents and accidents have identified inadequate flight crew monitoring and cross-checking as a problem for aviation safety. Therefore, to ensure the highest levels of safety for each flight, crew members must carefully monitor the aircraft's flight path and systems and actively cross-check the actions of other crew members. Effective monitoring and cross-checking can be the last barrier or line of defence against accidents because detecting an error or unsafe situation may break the chain of events leading to an accident. Conversely, when this layer of defence is absent, errors and unsafe situations may go undetected, leading to adverse safety consequences.

It is difficult for humans to monitor for errors on a continuous basis when these errors rarely occur. Monitoring during high workload periods is important since these periods present situations in rapid flux and because high workload increases vulnerability to error. However, studies show that poor monitoring performance can be present during low workload periods, as well. Lapses in monitoring performance during lower workload periods are often associated with boredom and/or complacency.

Crew monitoring performance can be significantly improved by developing and implementing effective SOPs to support monitoring and cross-checking functions, by training crews on monitoring strategies, and by pilots following those SOPs and strategies. This Appendix focuses on the first of these components, developing and implementing SOPs to improve monitoring.

A fundamental concept of improving monitoring is realising that many crew errors occur when one or more pilots are off-frequency or doing heads-down work, such as programming a Flight Management System (FMS). The example SOPs below are designed to optimise monitoring by ensuring that both pilots are "in the loop" and attentive during flight phases where weaknesses in monitoring can have significant safety implications.

Review and Modification of Existing SOPs

Some SOPs may actually detract from healthy monitoring. The AOC holder should review existing SOPs and modify those that can detract from monitoring.

For example, one AOC holder required a PA announcement when climbing and descending through 10,000 feet. This requirement had the unintended effect of "splitting the cockpit" at a time when frequency changes and new altitude clearances were likely. When the AOC holder reviewed its procedures, it realised that this procedure detracted from having both pilots "in the loop" at a critical point and consequently decided to eliminate it.

Another AOC holder required a company radio call to operations once the aircraft had landed. A critical review of procedures showed that this requirement, although sometimes necessary, had resulted in runway incursions because the first officer was concentrating on making this radio call and not fully monitoring the captain's taxi progress. The procedure was modified so that crews make this call only when necessary and then only once all active runways are crossed, unless unusual circumstances warrant otherwise (such as extensive holding on the ground).

In addition to modifying existing SOPs, the AOC holder may consider adding sections to the SOP manual to ensure that monitoring is emphasised, such as high-level SOPs that send an over-arching message that monitoring is a very important part of cockpit duties.

Examples of such high-level SOPs:

(a) The SOP document could explicitly state that monitoring is a primary responsibility of each crewmember.

Example

Monitoring Responsibility: The PF will monitor/control the aircraft, regardless of the level of automation employed. The PM will monitor the aircraft and actions of the PF.

Rationale

(i) Several AOC holders have made this change because they feel it is better to describe what that pilot should be doing (monitoring) rather than what he/she is not doing (not flying).

(ii) Although some SOP documents do define monitoring responsibilities for the PF, this role is often not explicitly defined for the PM. In many cases non-monitoring duties, such as company-required paperwork, PA announcements, operating gear and flaps, are clearly spelled-out, but seldom are monitoring duties explicitly defined for each pilot.

(b) SOPs to support monitoring during airport surface operations

Examples

(i) Both pilots should have taxi charts available. A flight crewmember—other than the pilot taxiing the aircraft—should follow the aircraft's progress on the airport diagram to ensure that the pilot taxiing the aircraft is following the instructions received from ATC.

(ii) Both pilots will monitor taxi clearance. Captain will verbalise to FO any hold short instructions. FO will request confirmation from Captain if not received.

(iii) When approaching an entrance to an active runway, both pilots will ensure compliance with hold short or crossing clearance before continuing with non-monitoring tasks (e.g., FMS programming, Airborne Communications Addressing and Reporting System (ACARS), company radio calls, etc.)

Rationale

Pilot-caused runway incursions often involve misunderstanding, not hearing a clearance or spatial disorientation. These SOPs are designed to do several things:

(i) The requirement for both pilots to have taxi charts out ensures that the pilot who is not actively taxiing the aircraft can truly back-up the pilot who is taxiing.

(ii) Requesting that both pilots monitor the taxi clearance and having the captain discuss any hold short instructions is a method to ensure that all pilots have the same understanding of the intended taxi plan.

(iii) The requirement to suspend non-monitoring tasks as the aircraft approaches an active runway allows both pilots to monitor and verify that the aircraft stops short of the specified holding point.

(c) SOPs to support improved monitoring during vertical segments of flight (refer to **Appendix C** of this AC, "ATC Communications and Altitude Awareness")

Examples

(i) PF should brief PM when or where delayed climb/descent will begin.

(ii) Perform non-essential duties/activities during lowest workload periods such as cruise altitude or level flight.

(iii) When able, brief the anticipated approach prior to top-of-descent.

(iv) During the last 1,000 feet of altitude change both pilots should focus on the relevant flight instruments to ensure that the aircraft levels at the proper altitude. (In VMC one pilot should include scanning outside for traffic; however, at least one pilot should focus on ensuring that the aircraft levels at the proper altitude.).

Rationale

A study on crew monitoring revealed that three-quarters of the monitoring errors in that study occurred while the aircraft was in a vertical phase of flight, i.e., climbing, descending or approach. These SOP statements ensure that proper attention can be devoted to monitoring during vertical phases of flight.

The monitoring study highlighted that a number of altitude deviations occurred when crews were given an altitude crossing restriction, but then failed to begin the descent in a timely manner. Briefing the anticipated top-of-descent point not only promotes healthy CRM, but also allows the other pilot to "back up" the planned descent point and ensure the descent begins at the proper point. Example: "We'll begin our descent at 80 DME."

Studies likewise show that in order to minimise the chance of a monitoring error, crews should schedule performance of non-essential duties/activities during the lowest workload periods, such as cruise altitude or level flight.

Briefing the anticipated instrument approach prior to descent from cruise altitude allows greater attention to be devoted to properly monitoring the descent because the crew does not have to divide attention between reviewing the approach and monitoring the descent. It also allows greater attention to be devoted to the contents of the approach briefing, which can increase situation awareness and understanding of the intended plan for approach and landing.

Many altitude deviations occur because pilots are not properly monitoring the level off. This SOP statement is to ensure that pilots concentrate on ensuring that the aircraft levels at the proper altitude, instead of being distracted by or performing non-monitoring tasks.

(d) SOPs to support improved monitoring of automation
(refer to **Appendix C** of this AC, “ATC Communications and Altitude Awareness”)

Examples

(i) Before flight, the routing listed on the flight release must be cross-checked against the ATC clearance and the FMS routing.

(ii) When making auto flight systems input, comply with the following items in the acronym CAMI:

Confirm FMS inputs with the other pilot when airborne
Activate the input
Monitor mode annunciation to ensure the auto flight system performs as desired
Intervene if necessary.

During high workload periods FMS inputs will be made by the PM, upon the request of PF. Examples of high workload include when flying below 10,000 feet and when within 1000 feet of level off or Transition Altitude.

Pilots should include scanning of the Flight Mode Annunciator as part of their normal instrument scan, especially when automation changes occur (e.g., course changes, altitude level off, etc.).

Rationale

It is not unusual for the routing that is loaded in the FMS to be different from the routing assigned by ATC, especially in those cases where the flight plan is uplinked directly into the FMS, or when an FMS stored company route is used. Various studies have demonstrated that FMS programming errors made during preflight are not likely to be caught by flight crews during flight. Therefore, it is critical that these items be cross-checked before takeoff.

The above-mentioned monitoring study found that 30 percent of the monitoring errors in that study’s dataset occurred when a crewmember was programming a Flight Management System (FMS). Another study showed that even experienced pilots of highly automated aircraft sometimes fail to adequately check the Flight Mode Annunciator to verify automation mode status. The acronym “CAMI” can be used to help emphasise cross-checking of automation inputs, monitoring and mode awareness.

The statement concerning FMS inputs during high workload allows the PF to concentrate on flying and monitoring by simply commanding FMS inputs during highly vulnerable times. Several reports indicate problems with failure to level-off and failure to reset altimeters to proper settings. Therefore, the definition of “high workload” should include those vulnerable phases

Automated flight guidance systems can have mode reversions and can sometimes command actions that are not anticipated by pilots. Therefore, pilots should include the Flight Mode Annunciator into their normal instrument scan. Special attention should be given to periods of course changes, altitude level off, etc.