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STANDARD OPERATING PROCEDURES FOR FLIGHT DECK CREW MEMBERS

1. PURPOSE

1.1 Standard operating procedures (SOPs) are universally recognized as basic to safe aviation operations. Effective crew coordination and crew performance, two central concepts of crew resource management (CRM), depend upon the crew's having a shared mental model of each task. That mental model, in turn, is founded on SOPs. This Circular presents background, basic concepts, and philosophy in respect to SOPs. It emphasizes that SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crew members.

1.2 This AC is designed to provide advice and recommendations about development, implementation, and updating of SOPs. Many important topics that should be addressed in SOPs are provided in Appendix 1, Standard Operating Procedures Template. Stabilized Approach, characterized by a constant-angle, constant-rate of descent ending near the touchdown point, where the landing manoeuvre begins, is among the SOPs specifically identified in this AC, and is described in Appendix 2, Stabilized Approach: Concepts and Terms.

1.3 AOC holders should refer to the Template in Appendix 1, to Stabilized Approach in Appendix 2, ATC Instructions in Appendix 3, Crew Briefings in Appendix 4 and to the aircraft manufactures recommended procedures in developing comprehensive SOPs for use in training programs and in manuals used by their flight deck crew members.

2. SCOPE

2.1 Appendix 1 consolidates many topics viewed by operators and by the DCA as important, to be addressed as SOPs in air operator training programs and in the manuals used by air operator flight deck crew members.

2.2 This AC does not list every important SOP topic or dictate exactly how each topic should be addressed by an AOC holder. Instead, this AC offers a baseline of topics, to be used as a reference. In practice, each AOC holder's manuals and training programs are unique. Each AOC holder could omit certain topics shown in the template when they do not apply, and, on the other hand, could add other topics not shown in the template when they do apply.

2.3 This AC contains guidance intended for use primarily by Air Operator Certificate holders authorized to conduct operations in accordance with The Union of Myanmar Aircraft Rules (1937).

3. RELATED REGULATIONS

a) The Union of Myanmar Aircraft Act (1934)
b) The Union of Myanmar Aircraft Rules (1937)

4. RELATED READING MATERIAL

4.1 Approach-and-landing Risk Awareness Tool (Ref. AIC 01/07).

4.2 CFIT Checklist (Ref. AIC 02/07)

4.3 Human Performance Considerations in the Use and Design of Aircraft Checklists in accordance with ICAO PANS/OPS Document 8168 and ICAO Human Factors Training Manual Document 9683.

5. BACKGROUND

5.1 For many years the International Civil Aviation Organization (ICAO) has identified deficiencies in standard operating procedures as contributing causal factors in aviation accidents. Among the most commonly cited deficiencies involving flight crews has been their non-compliance with established procedures; another has been the non-existence of established procedures in some manuals used by flight crews.

5.2 The ICAO has recognized the importance of SOPs for safe flight operations. Recent amendments to ICAO Annex 6 and PANS OPS Document 8168, Vol. I, establish that each Member State shall require that SOPs for each phase of flight be contained in the operations manual used by pilots.

5.3 Many Aviation Safety Organizations have concluded that Air Operators perform with higher levels of safety when they establish and adhere to adequate SOPs.

5.4 A study of CFIT accidents found almost 50 percent of the 107 CFIT interventions identified by an analysis team related to the flight crew's failure to adhere to SOPs or the AOC holder's failure to establish adequate SOPs.

6. THE MISSION OF SOPs

6.1 To achieve consistently safe flight operations through adherence to SOPs that are clear, comprehensive, and readily available to flight crew members.

7. APPLYING THE SOPs TEMPLATE AND OTHER APPENDICES

7.1 Generally, each SOP topic identified in the template (following as Appendix 1) is important and should be addressed in some manner by the AOC holder, if applicable. Stabilized Approach (Appendix 2) 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 should be addressed as well, when 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 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: “ABC Airlines does not conduct Category 3 approaches.”

8. KEY FEATURES OF EFFECTIVE SOPs

8.1 Many experts agree that implementation of any procedure as an SOP is most effective if:

8.1.1 The procedure is appropriate to the situation.

8.1.2 The procedure is practical to use.

8.1.3 Crew members understand the reasons for the procedure.

8.1.4 Pilot Flying (PF), Pilot Not Flying (PNF), and Flight Engineer duties are clearly delineated.

8.1.5 Effective training is conducted.

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

8.2 If all elements (above) are not consistently implemented, flight crews too easily become participants in an undesirable double standard condoned by instructors, check pilots, and managers. Flight crews 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.

9. THE IMPORTANCE OF UNDERSTANDING THE REASONS FOR AN SOP

9.1 **Effective Feedback.**

9.1.1 When flight crew members understand the underlying reasons for an 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.

9.2 **Troubleshooting.**

9.2.1 When flight crew members understand the underlying reasons for an 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.

10. COLLABORATING FOR EFFECTIVE SOPs

10.1 In general, effective SOPs are the product of healthy collaboration among managers and flight operations people, including flight crews. A safety culture promoting continuous feedback from flight crews and others, and continuous revision by the collaborators distinguishes effective SOPs at air operators of all sizes and ages.

10.2 New operators, operators adding a new aircraft fleet, or operators retiring one aircraft fleet for another must be especially diligent in developing SOPs. Collaborators with applicable experience may be more difficult to bring together in those instances.

10.3 For a start-up AOC holder, this AC and its Appendices should be especially valuable tools in developing SOPs. The developers 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 airplane manufacturer, pilots having previous experience with the airplane or with the kind of operations planned by the operator, and representatives from the DCA. It is especially important for a new operator 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 to reach valid conclusions for revisions. The review process will be meaningful and effective when managers promote prompt implementation of revisions to SOPs when necessary.

10.4 An existing AOC holder introducing a new airplane fleet should also collaborate using the best resources available, including the AFM and operations bulletins. Experience has shown that representatives of the airplane manufacturer, managers, check pilot, 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.

10.5 Long-established operators should be careful not to assume too readily that they can operate an airplane recently added to the fleet in the same, standard way as older types or models. Managers, check pilot, and instructors should collaborate using the best resources available, including the AFM

and operations bulletins to ensure that SOPs developed or adapted for a new airplane are in fact effective for that aircraft, and are not inappropriate carry overs.

11. SUMMARY

11.1 Safety in commercial aviation continues to depend on good crew performance. Good crew performance, in turn, is founded on standard operating procedures that are clear, comprehensive, and readily available to the flight crew. This AC provides an SOPs template and many other useful references in developing SOPs. Development of SOPs is most effective when done by collaboration, using the best resources available including the end-users themselves, the flight crews. Once developed, effective SOPs should be continually reviewed and renewed.

Director General
Department of Civil Aviation

NOTES ON APPENDICES

The following appendices contain examples of standard operating procedures (SOPs) that are identical to or similar to some SOPs currently in use. Those examples do not represent a rigid DCA view of best practices, which may vary among fleets and among AOC holders, and may change over time.

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

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APPENDIX 1

STANDARD OPERATING PROCEDURES 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 DCA alike as examples of topics that constitute a useful template for developing comprehensive, effective SOPs:

Captain's authority

Use of automation

- The operator'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
- Preliminary landing
- Landing
- After landing
- Parking and securing
- Emergency procedures
- Non-normal/abnormal procedures

Communications

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

Briefings

- CFIT risk considered
- Special airport qualifications considered
- Temperature corrections considered
- Before takeoff
- Descent/approach/missed approach
- Approach briefing general done prior to beginning of descent
- Flight deck access
- On ground/in flight
- Jump 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 of altitude change

Report times

- Check in/show up
- On flight deck
- Checklist accomplishment

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
- Count/load

Pushback/powerback

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
- Cabin Crew
- Flight crew

Weight & balance/cargo loading

- Who is responsible for loading cargo, and securing cargo
- Who prepares the weight & balance data form; who checks it
- Copy to crew

Flight deck/cabin crew interchange

- Boarding
- Ready to taxi
- Cabin emergency
- Prior to take-off/landing

Take-off

- PF/PNF duties and responsibilities
- Who conducts it?
- Briefing, IFR/VFR
- Reduced power procedures
- Tailwind, runway clutter
- Intersections/land and hold short procedures (LAHSO)
- Noise abatement procedures
- Special departure procedures
- Flight directors
- Use of: Yes/No
- Callouts
- Clean up
- Loss of engine
- Transfer of controls - if appropriate
- Rejected takeoff
- After V1
- Actions/callouts
- Flap settings
- Normal
- Nonstandard and reason for
- Crosswind
- Close-in turns

Climb

- Speeds
- Configuration
- Confirm compliance with climb gradient required in departure procedure
- Confirm appropriate cold temperature corrections made

Cruise altitude selection

- Speeds/weights

Position reports/ pilot weather reports

- ATC - including pilot report of hazards such as icing, thunderstorms and turbulence
- Company

Emergency descents

Holding procedures

- Procedures for diversion to alternate

Normal descents

- Planning and discussing prior to beginning of descent point
- Risk assessment and briefing
- Speed brakes: Yes/No
- Flaps/gear use
- Icing considerations
- Convective activity

Ground proximity warning system (GPWS or TAWs)

- Escape manoeuvre

TCAS

Windshear

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

Approach philosophy

- Monitoring during approaches
- Precision approaches preferred
- Stabilized approaches standard
- Use of navigation aids
- Flight management system (FMS)/autopilot
- Use, and when to discontinue use
- Approach gates
- Limits for stabilized approaches
- Use of radio altimeter
- Go-around: Plan to go around; change plan to land when visual, if stabilized

Individual approach type

- All types, including engine-out

For each type of approach

- Profile
- Airplane configuration for conditions
- Visual Approach
- Low visibility
- Contaminated runway
- Flap/gear extension
- Auto spoiler and auto brake systems armed and confirmed armed by both pilots, in accordance with manufactures recommended procedures (or equivalent approved company procedures)
- Procedures - Actions and Callouts

Go-around / missed approach

- When stabilized approach gates are missed
- Procedure - Actions and Callouts
- Clean-up profile

Landing

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

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APPENDIX 2

STABILIZED APPROACH: CONCEPTS AND TERMS

A stabilized approach is one of the key features of safe approaches and landings in air operator operations, especially those involving transport category airplanes.

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

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 stabilized by 1000' height above threshold (HAT) in instrument meteorological conditions (IMC), and by 500' HAT in visual meteorological conditions (VMC). An approach that becomes unstabilized below the altitudes shown here requires an immediate go-around.

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

- The airplane is on the correct[1] track.

- The airplane 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 Jeppesen) 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 airplane 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 feet per minute (fpm).

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

- 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.

Power setting is appropriate for the landing configuration selected, and is within the permissible power range for approach specified in the approved operating manual used by the pilot.

When no vertical guidance is provided: Vertical guidance may be provided to the pilot by way of an electronic glide slope, 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 other points selected by the flight crew are passed. 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 in all but special cases.

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, if unable, should perform a missed approach.

No visual contact. The operator 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 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.

Note [1]: **A correct track** is one in which the correct localizer, radial, or other track guidance has been set, tuned, and identified, and is being followed by the pilot.

Note [2]: **Normal bracketing corrections** relate to bank angle, rate of descent, and power management. Recommended ranges are as follows (operating limitations in the approved airplane flight manual must be observed, and may be more restrictive):

Course Guidance: Specific types of approach are stabilized if they also fulfil the following:

Instrument Landing Systems (ILS) must be flown within +/- one (1) dot of the glide slope and localizer; Category II or Category III ILS approach must be flown within the expanded localizer band; during a circling approach, wing 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 stabilized approach require a special briefing.

Bank angle: Maximum bank angle permissible during approach is specified in the approved operating manual used by the pilot, 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: ±300 fpm deviation from target

Power management: Permissible power range is specified in the approved operating manual used by the pilot.

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 3

ATC COMMUNICATIONS

and

ALTITUDE AWARENESS

ATC Communications: SOPs should state who (PF, PNF, 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; and

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.

d. Other clearances or instructions including, conditional clearances, shall be read back or acknowledged in a manner to clearly indicate that they have been understood and will be complied with.

e. PF makes input to aircraft/autopilot and/or verbally states clearances while PNF confirms input is what he/she read back to ATC.

f. Any confusion in the flight deck is immediately cleared up by requesting ATC confirmation.

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

h. Company policy should address use of speakers, headsets, boom mike and/or hand-held mikes.

i. Company personnel will 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.

Example: The PNF acknowledges ATC altitude clearance. If the aircraft is on the autopilot then the PF makes input into the autopilot/altitude alerter. PF points to the input while stating the assigned altitude, as he/she understands it. The PNF then points to the input stating aloud what he/she understands the ATC clearance to be confirming that the input and clearance match.

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

Example: If there is no altitude alerter in the aircraft then both pilots write down the clearance, confirm that they have the same altitude and then cross off the previously assigned altitude.

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APPENDIX 4

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 (subsequent flight, if applicable). The captain 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
- Altimeter setting units
- Use of delayed engine start and/or engine out taxi procedures

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

Take-off 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
- Close-out weight 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.

Cabin Crew Briefing

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

Upon flight origination or whenever a crew change occurs, the captain 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, company policy is that the captain must brief the lead cabin crew. The briefing will be supplemented with a completed Cabin Crew Briefing Form. The briefing should cover the following items:

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

- 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., “Code 4 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 preflight announcements or cabin service.

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

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

During the briefing, the captain should solicit feedback for operational concerns (e.g., does each person understand the operation of the emergency exits and equipment). The captain should also solicit feedback for information which may affect expected team roles. Empower each crew member 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 will inform the captain of any inoperative equipment and the number of cabin crew on board. The captain will inform the lead cabin crew when there are significant changes to the operation of the flight after the briefing has been conducted.

APPENDIX 5

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 each flight crew member 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 defense against accidents because detecting an error or unsafe situation may break the chain of events leading to an accident. Conversely, when this layer of defense 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 realizing 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 optimize monitoring by ensuring that both pilots are “in the loop” and attentive during those 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. Operators should review existing SOPs and modify those that can detract from monitoring. For example, one air operator 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 air operator reviewed its procedures it realized that this procedure detracted from having both pilots “in the loop” at a critical point and consequently decided to eliminate it.

Another operator 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, operators may consider adding sections to the SOP manual to ensure that monitoring is emphasized, such as:

- High-level SOPs that send an over-arching message that monitoring is a very important part of cockpit duties.

Examples:

A. The SOP document could explicitly state that monitoring is a primary responsibility of each crew member.

B. Monitoring Responsibility
   - The PF will monitor/control the aircraft, regardless of the level of automation employed.
   - The PNF will monitor the aircraft and actions of the PF.

Rationale:

A. Several air operators 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).

B. Although some SOP documents do define monitoring responsibilities for the PF, this role is often not explicitly defined for the PNF. 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.

SOPs to support monitoring during airport surface operations.

Examples:

A. Both pilots will have taxi charts available. A flight crew member, 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.

B. Both pilots will monitor taxi clearance. Captain will verbalize to FO any hold short instructions. FO will request confirmation from Captain if not received.

C. 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.

A. 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.

B. 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.

C. 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.

SOPs to support improved monitoring during vertical segments of flight (also refer to Appendix 3 of this document, “ATC Communications and Altitude Awareness”)

Examples:

A. PF should brief PNF when or where delayed climb/descent will begin.

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

C. When able, brief the anticipated approach prior to top-of-descent.

D. 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. (When 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.

A. 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."

B. Studies likewise show that in order to minimize 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.

C. 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 is not having 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.

D. Many altitude deviations occur because pilots are not properly monitoring the level off.

This SOP statement is to ensure that pilots concentrate on ensuring the aircraft levels at the proper altitude, instead of being distracted by or performing non-monitoring tasks.

SOPs to support improved monitoring of automation

Examples:

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

B. When making auto flight systems inputs, 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.

C. During high workload periods FMS inputs will be made by the PNF, 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.

D. 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:

A. 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.

B. The above-mentioned monitoring study found that 30 percent of the monitoring errors in that study's dataset occurred when a crew member was programming a Flight Management System (FMS). Another study showed that even experienced pilots of highly automated aircraft sometime fail to adequately check the Flight Mode Annunciator to verify automation mode status. The

acronym “CAMI” can be used to help emphasize cross-checking of automation inputs, monitoring and mode awareness.

C. 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.

D. 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.)