DOCKET NO. SA-510

EXHIBIT NO. 2B

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ADDENDUM TO
OPERATIONS GROUP CHAIRMAN'S
FACTUAL REPORT
UNITED AIRLINES
ADVANCED MANEUVERS PACKAGE

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

November 22, 1994

ADDENDUM TO THE OPERATIONS

GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION

A. ACCIDENT: DCA-94-MA-076

Location:	Aliquippa, Pennsylvania
Date:	September 8, 1994
Time:	1904 Eastern Daylight Time
Airplane:	Boeing 737-300, N513AU

B. ADDENDUM

1. BACKGROUND

On November 17, 1994, the Investigator-In-Charge, Thomas Haueter, and the Operations Group Chairman, Charles Leonard, visited the United Airlines Training Facility, in Denver, Colorado, to evaluate a new simulator training program being implemented by the airline.

The program, identified as the Advanced Maneuvers Package, was developed over a 2 year period, by United training captains, in response to unusual incidents that had occurred in line operations, and a belief that aircrews could be trained in the simulator to recover from such rare events without significantly impacting the length of training. It was felt that airline pilots fly within such operationally narrow performance parameters that it limits their confidence to respond to events that exceed this limited envelope.

Captain Larry Walters, the Program Manager, briefed the Safety Board Investigators for 3 hours on the details of the program, including; the background, how it has been implemented, the impact on training time, and the aircrew response. This was followed by a 2 hour simulator session, during which time the maneuvers were performed by the Safety Board Investigators, under the supervision of Captain Walters.

Initially, the training was provided to simulator instructors assigned to the B-757/767 fleet. The response of this group was so enthusiastic, that it was merged into the

training of line pilots in these airplanes. In order to achieve standardization, Captain Walters trained each instructor in the maneuvers. Since July 1994, every flightcrew training in the B-757/767 has received the Advanced Maneuvers Package. Over 180 pilots have received this training. The response of these flightcrews has been overwhelmingly positive. Based on this, the United Airlines Director of Training directed that this program be implemented in the entire United fleet, a goal targeted to be completed by early 1995.

2. Program Highlights

The Advanced Maneuvers Package currently consists of thirteen specific profiles. It was emphasized by Captain Walters that the program is still being developed and modified. The FAA Principal Operations Inspector for United has been consulted about this new training, and inspectors from his office have flown the maneuvers. It was reported that they also were favorably impressed with the value of the maneuvers.

The objective of the training is to enhance flightcrew development in the following areas:

* Flight skills and knowledge

* Situational awareness

* Pilot self-confidence

* Pilot confidence in the aircraft

Each of the maneuvers is described in detail in the attachments to this addendum. Extracted from the attachments are 5 of the maneuvers. These are summarized as follows:

a. SLOW FLIGHT

This is described as a warm-up maneuver, designed to introduce the pilot to maneuvering the airplane at the lower airspeed ranges, involving high angle of attack and reduced lift. While in a clean configuration, the flightcrew reduces the airspeed until the stick shaker activates. The pilot makes note of this speed and accelerates to 5 knots (10 knots in 767) above the shaker.

After some straight and level stabilized flight, the pilot is asked to perform turns as near 30 degree bank as possible. The stick shaker will sound as bank is increased, and the pilot varies the bank angle to eliminate the shaker. Reducing bank angle will not be sufficient to maintain the airspeed, and the pilot notes the need for large throttle movements. During the maneuver, the pilot maintains level flight.

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Some of the problems observed include:

* Poor instrument scan

* Inability to maintain airspeed and altitude due to poor throttle control

* Poor bank control resulting in loss of airspeed and altitude

b. FULL STALLS

The objectives of this maneuver are to develop techniques to effect a recovery from such a condition and to enhance the pilot's confidence in the airplane.

The maneuver is recommended to be accomplished twice by each pilot. The first time to observe the handling characteristics during a full stall condition, and the second time to note the recovery technique.

The pilot reduces the throttles to idle while in a clean configuration and stops trimming when reaching the stick shaker airspeed. The airspeed is allowed to decrease into the buffet while maintaining the entry altitude. The instructor points out the difference between buffet and stick shaker warning.

When the yoke is fully back, the VSI will start decreasing, and the airplane has completely stalled. The pilot is asked to feel the roll authority by applying aileron input in each direction. The purpose is for demonstration of airplane capability and not as a recommended recovery technique. While the airplane is still fully stalled, and the yoke fully back, the pilot is asked to apply full power. The pilot observes that thrust alone will not result in stall recovery. The pilot relaxes back pressure and allows the nose of the airplane to drop below the horizon. The airplane will pitch up as the airspeed increases and leaves the buffet area. The stabilizer is out of trim, causing this strong pitch up tendency.

The pilot recovers to the entry altitude, observing how easy it is to initiate the stick shaker unless pitch control is smooth. The maneuver is repeated until the pilot can recover without reentering a secondary stall.

Some of the problems that are encountered are:

* The pilot does not hold the airplane in a full stall condition.

* The pilot does not push the nose sufficiently below the horizon to recover from the stall.

* The pilot overcontrols the elevators causing secondary stalls and poor recovery from the stall.

c. ROLLS AND RETURNS

The purpose of this maneuver is to develop techniques for very high bank angle recoveries. It teaches the need for the smooth application of flight controls and again develops pilot self-confidence. After completion of these maneuvers, the pilot should be able to recover from a 135 degree bank angle without using violent flight control inputs.

The simulator should be about 10,000 feet AGL, so that the pilot is not overly concerned about the height above the ground during the recovery. In a clean configuration, the pilot reduces the airspeed to maneuvering speed. First, the pilot rolls smoothly into a 60 degree bank using the maximum aileron deflection and returns to 0 degree bank. The pilot then smoothly applies full rudder and observes the airplane roll characteristics, and returns to wings level by reducing the rudder.

Next, the pilot rolls the airplane rapidly into an approximately 90 bank by the use of aileron only and returns to wings level. The pilot is asked to observe the nose drop during the maneuver. Another 90 degree bank is entered using only aileron for entry, but this time both aileron and rudder are used for the recovery. The pilot observes the improved roll rate when rudder is applied, and the decrease in how far the nose drops.

The pilot is asked to cross check the standby attitude indicator during this maneuver, in order to reinforce the importance of such a technique in the event of a high bank angle.

The pilot then initiates rolls to higher bank angles, such as 135 degrees, and performs the same recovery techniques; first with aileron only and then with aileron and rudder. The "sky pointer" on the attitude indicator is the reference point for recovery. The procedure "step and roll" towards the sky pointer is emphasized. In addition, the importance of rolling the wings near level before pulling the nose towards the horizon is discussed. The maneuver requires smooth flight control inputs and G load awareness.

d. UPSET RECOVERY

This maneuver most closely resembles the "unusual attitude" recovery that has been part of all pilot training, for both civilian and military programs. The purpose of this training is:

* Observe the airplane performance well outside that normally experienced in airline operation

* Develop the techniques for recovery from extremely unusual attitudes, nose up or nose down, and or high bank angles or 0 bank angles

Two upsets are demonstrated: (1) an extreme bank angle resulting in a nose-down attitude, started in a clean configuration; and (2) an extreme nose-up attitude, entered from 250 knots. The maneuver is performed at both low and high altitudes.

For the extreme nose-up attitude, with low airspeed, emphasize the recovery technique of rolling the airplane to a 90 degree bank and allowing the nose to drop to the horizon. The pilot should be cross checking the airspeed and if it is low, the application of bottom rudder would assist in starting the nose to drop. When the nose lowers to the horizon, the pilot rolls the wings level and applies back pressure to level the airplane, only after the airspeed increases.

If the nose is extremely low and the airspeed rapidly increasing, the pilot should retard the throttles to idle as the wings are leveled. The use of smooth elevator controls should be emphasized to preclude a high-speed buffet and secondary stall.

e. ENGINE FAILURE AFTER V2

This maneuver occurs at a "surprise" point, such as after a go-around, or after a normal takeoff, and the aircraft pitch is at 20 degrees nose up. The training objective is to develop the pilot's ability to fly the airplane when an engine failure occurs at low airspeed and altitude and high pitch attitude. The maneuver is designed to provide simple, easy-to-recall procedures for such an event and to avoid incorrect flight control inputs.

The first action, after engine failure recognition, would be to lower the pitch attitude to 12.5 degrees using the ADI. Next the pilot levels the wings initially using ailerons only. Rudder is applied after observing the yoke displacement, and coordinated with aileron. Use of this method should prevent the pilot from applying the incorrect rudder.

Some of the problems encountered included:

* Failure to obtain the proper pitch attitude (12.5 degrees)
* Failure to level the wings
* Failure to apply the correct rudder
* Overcontrolling flight controls

3. SUMMARY

The implementation of this training into the simulator has been accomplished at a minimum of additional time. On each simulator session, one or two of these maneuvers are introduced at the end of the training period. The training captains have indicated that the maneuvers are extremely well received by the trainees. In addition, these instructors report that this training appears to improve student performance in other maneuvers, thereby reducing the time required to obtain proficiency in certain training. This unexpected "payback" may result in minimizing the amount of additional time needed.

The program at United will include review of the maneuvers during flightcrew recurrent training, both in the classroom and in the simulator. These are not considered to be "checking" maneuvers, but rather are presented for familiarization and to enhance confidence.

The United Simulator Engineering Department has been consulted in the development of the program, and there have been no modifications required. The simulators have performed without any reported problems as of this time.

[redacted]
Charles F. Leonard
Chairman, Operations Group

Attachments

1. Draft: Advanced Maneuvers Package
2. Draft: B-757/767 Instructor Manual

ATTACHMENT 1

DRAFT: ADVANCED MANEUVERS PACKAGE

UNITED AIRLINES
B-757/767 PROGRAM DESIGN
ADVANCED MANEUVERS PACKAGE
SIMULATOR DEMONSTRATION

OBJECTIVES OF THE ADVANCED MANEUVERS PACKAGE

INTRODUCE ADVANCED MANEUVERS TO ENHANCE **FLIGHT SAFETY** WITH:

- FLIGHT SKILLS AND KNOWLEDGE
- SITUATIONAL AWARENESS
- PILOT SELF-CONFIDENCE
- PILOT CONFIDENCE IN THE AIRCRAFT

IMPROVE BASIC FLIGHT/NAVIGATION SKILLS BY:

- FIRMLY ESTABLISHING BASIC SKILLS BEFORE MOVING ON TO OTHER SUBJECTS
- THE USE OF BASIC INSTRUMENTS AND RADIO NAV BEFORE FMC AND AUTOFLIGHT

FEATURES OF THE TRAINING PROGRAM DESIGN

ADVANCED PHASED EVALUATION CONCEPT

- SYSTEMS KNOWLEDGE EVALUATION
- FLIGHT/NAVIGATION SKILLS EVALUATION
- CORE FLIGHT MANEUVERS EVALUATION
- LINE OPERATIONAL EVALUATION (LOE)

IMPROVED LEARNING PROCESS

- FOCUSED LEARNING APPROACH
- BUILDING-BLOCK PHILOSOPHY
- IMPROVED GROUND SCHOOL DESIGN
- ENHANCED FLIGHT/NAVIGATION SKILLS TRAINING AND ASSESSMENT
- CONCENTRATED CORE FLIGHT MANEUVERS TRAINING
- MORE LOFT PERIODS WITH HEAVY CRM EMPHASIS

UNITED AIRLINES
B-757/767 PROGRAM DESIGN
ADVANCED MANEUVERS PACKAGE
SIMULATOR DEMONSTRATION

FULL STALL (15000 FEET, CLEAN, HOLD FULL ELEVATOR, NO TRIM BELOW STICK SHAKER)
- DEMO AILERON AUTHORITY
- ADD FULL POWER, DEMO NO RECOVERY WITH POWER ONLY
- PUSH NOSE DOWN TO GET OVER STICK SHAKER, AVOID PITCH UP
- CLIMB BACK TO ALTITUDE AT 15 DEGREES NOSE UP

ROLLS AND RETURNS (AT MANEUVERING SPEED, RETURN TO 15000 FEET EACH TIME)
- DISCUSS IMPORTANCE OF SMOOTH AND LARGE CONTROL INPUTS
- DISCUSS G-LOAD AWARENESS
- PERFORM ROLLS TO 90, 120, AND 135 DEGREE BANKS AND RETURNS
- NOTICE NOSE FALL-THROUGH
- DISCUSS IMPORTANCE OF RUDDER WHEN ROLLING BACK TO UPRIGHT
- STRESS **NOT PULLING BACK ON ELEVATOR BEFORE WINGS LEVEL UPRIGHT**
- DISCUSS RELATIVE VALUE OF NOSE ATTITUDE VS THRUST OR DRAG FOR RECOVERY

UPSET RECOVERY (CLEAN, 250K)
- HIGH-BANK UPSET
  - PILOTS LOOK AWAY AND INSTRUCTOR ROLLS TO 135, PILOT RECOVERS
- HIGH-PITCH UPSET
  - DISCUSS USEFULNESS OF BANK TO CONTROL PITCH
  - PULL NOSE UP TO 40 DEGREES
  - DEMO ROLL INTO HIGH BANK TO ASSIST IN RECOVERY

REDUCED TRIM APPROACH (SET TRIM TO 3.0, TURN OFF TRIM SWITCHES, PUSH FLAP OVERRIDE)
- IP TO 9 MILE FINAL, SET GEAR DOWN AND FLAPS 20 TO SIMULATE HYDRAULIC FAILURE.
- REDUCED TRIM VISUAL ILS APPROACH AND LANDING (SPEED FLAPS 20 REF + 10K)
- TEACH TECHNIQUE AS NECESSARY SUCH AS HAVING PNF ASSIST WITH ELEVATOR USING COLUMN

UNITED AIRLINES
B-757/767 PROGRAM DESIGN
ADVANCED MANEUVERS PACKAGE
SIMULATOR DEMONSTRATION

RELIGHT ENGINE (RUDDER TRIM TO ZERO)
- ACCELERATE TO 300K
- SLEW ALTITUDE TO FL 410 (10000 FT AT A TIME)
- SLEW AIRSPEED TO MACH 0.80

HIGH SPEED DEMO
- SLEW SPEED ABOVE VMO TO DEMO HIGH-SPEED BUFFET (NOTE FEELING)
- DEMO PITCHUP WITH GEAR AND SPEED BRAKE EXTENSION (HAND FLY)
- DISCUSS SLOW TURN RATE FOR TRAFFIC AVOIDANCE (BETTER TO FOLLOW TCAS COMMANDS)
- DISCUSS THUNDERSTORM AVOIDANCE AT HIGH SPEED (SLOW TURN RATE, PLAN AHEAD)

HIGH ALTITUDE UPSET RECOVERY (FL 410, ON A/P, MACH 0.80)
- DISCUSS IMPORTANCE OF GENTLENESS AND SMOOTHNESS AT HIGH SPEED
- INSTRUCTOR INPUT ROLL TO 90 DEGREE BANK, PILOT RECOVERS
- DISCUSS IMPORTANCE OF DISENGAGING AUTOPILOT BEFORE CONTROL INPUTS AND DANGER OF OVERPOWERING AUTOPILOT (A/P TRIMS AGAINST YOU)
- HOLD NOSE-DOWN PITCH WHILE A/P ENGAGED TO ALLOW A/P TO TRIM AGAINST PRESSURE
  - SMOOTHLY RELEASE PRESSURE TO ALLOW AIRCRAFT TO PITCH UP, THEN RECOVER

HIGH-ALTITUDE ENGINE FAILURE OR SHUTDOWN
- DISCUSS AND USE BASIC PARTS OF PROPOSED PROCEDURE
- INITIATE A DISTRESS MESSAGE (AS IF ON DOMESTIC AIRWAYS)
  - SPEAK SLOWLY SO THAT MESSAGE CAN BE COMPREHENDED AND COPIED
  - MAYDAY, IDENT, POSITION, ALTITUDE, NATURE OF DISTRESS, REQUEST VECTORS

FORGOTTEN SPEED BRAKE DEMONSTRATION (IP 3-MILE FINAL, F/D ON)
- DISCUSS HOW EASY IT IS TO FORGET THAT SPEED BRAKE IS DEPLOYED
- POINT OUT CLUES THAT SPEED BRAKE IS DEPLOYED
  - NOTE HIGH NOSE ATTITUDE ON FINAL (TAIL SKID AT JUST OVER 11 DEGREES)
  - NOTE "EYEBROWS" ON ADI ARE NEAR PITCH BAR
  - NOTE HOW AIRCRAFT FEELS BEFORE CROSSING THRESHOLD
- RETRACT SPEED BRAKE AND NOTE PITCH-OVER

ATTACHMENT 2

DRAFT: INSTRUCTOR MANUAL

*?? SLOW FLIGHT

OBJECTIVES

- A warm-up maneuver to develop or refresh a good instrument scan.
- To introduce the pilot to maneuvering the airplane with reduced thrust or lift capacity.
- To develop confidence in the aircraft by demonstrating its capabilities.

STANDARDS

- This is a training maneuver.
- The pilot should be able to maintain the airspeed with 5 knots and the altitude within 100 feet.

PREPARATION

TECHNIQUES

- In a clean configuration, have the pilot reduce the airspeed until the stick shaker, note the airspeed and accelerate to 5 knots (10 knots for 767) above the stall warning speed.
- At that speed, ask the pilot to maintain heading, altitude and airspeed.
- Large throttle movements will be necessary to maintain the airspeed.
- After some straight and level practice, ask the pilot to make turns using as near 30-degree bank as possible. The stick shaker will occasionally sound during this effort.
- When the stick shaker sounds while the airplane is on speed, have the pilot control the stick shaker onset by varying the bank angle.
- Once the airspeed or altitude gets below the target, it will be necessary to reduce the bank angle to recover.

BRIEFING NOTES

- Flying with a heavy load of ice on the bottom of the wings and fuselage is an example of the need for this skill.
- Discuss the use of bank to control the performance of an aircraft with limited lift.

PROBLEMS

- Poor scan.
- Inability to maintain airspeed and altitude due to poor throttle control.
- Poor bank control resulting in continuous loss of airspeed and altitude.

*?? FULL STALLS

OBJECTIVES

- To develop a technique for recovery from a full stall.
- To develop confidence in the aircraft by demonstrating its capabilities.

STANDARDS

- This is a training maneuver not to be checked.
- The pilot should be able to recover from the stall within 1500 feet without entering a secondary stall.

PREPARATION

TECHNIQUES

- Plan to do this maneuver twice for each pilot, once to observe the aircraft handling characteristics, and once to practice the recovery technique.
- Begin the maneuver at least 10000 feet AGL.
- In a clean configuration, have the pilot close the throttles to reduce the airspeed with no trimming below the stick shaker airspeed.
- Continue speed reduction into the buffet while holding the entry altitude. Point out the difference between the buffet and the stick shaker warning.
- When the yoke has reached full back and the aircraft has completely stalled as indicated by the VSI, have the pilot feel the roll authority of the ailerons. This not a part of the suggested recovery maneuver but rather a demonstration of the capability of the aircraft.
- While holding full back on the yoke and still in the stall, have the pilot apply full thrust to demonstrate the inability of the aircraft to recover with thrust only.
- Have the pilot push forward on the yoke to put the nose below the horizon to break the stall. Note the tendency of the aircraft to pitch up as it flies out of the buffet due to the stabilizer trim position.
- Fly the aircraft back to the recovery attitude of 15 degrees ANU working in and out of the buffet in the process.
- Climb or slewback to a higher altitude and repeat the maneuver as necessary until pilot is able to recover without entering the secondary stall.

BRIEFING NOTES

- The B-757/767 aircraft stalls in a very straight-forward manner with no unusual flight characteristics.
- Unlike many other transport aircraft, this aircraft has aileron authority while in the full stall.
- It is useful to know that there is adequate warning before entering the stall and that the stick shaker usually precedes the buffet at slow speeds and the reverse is true at high speeds.
- If the aircraft is flown inadvertently into a full stall, it is quite likely that the stabilizer will have been trimmed to a significantly nose-up position.
- The recovery from a full stall with the stabilizer trimmed to a very slow speed is quite different from the conventional recovery from the approach to stall that we demonstrate on the rating ride and proficiency evaluation.
- The recovery from a full stall as demonstrated here will require a significantly nose-down attitude to regain a flying angle of attack. For the pilot this will be a very counter-intuitive action when near the ground, especially since the pilot will have been trained to not push forward on the yoke during the recovery from the conventional approach to stall.
- During the recovery with the stabilizer trim in a nose-up position and with the application of full thrust, the aircraft will tend to pitch up causing a secondary stall to occur. The pilot should anticipate that and be prepared to counter the pitch-up smoothly.
- An awareness of the G forces caused by violent control inputs is essential in avoiding damage to the aircraft and injury to passengers and crew. Further, the aircraft responds most efficiently to smooth, measured control inputs.
- The 15-degree nose-up attitude is a familiar position used for other maneuvers and can be used here as a target recovery attitude.

PROBLEMS

- The pilot may not be willing to hold the aircraft in a full stall.
- The pilot may not push the nose of the aircraft sufficiently below the horizon and not recover from the stall.
- The pilot may not avoid the secondary stall by anticipating the pitch-up resulting from the stabilizer trim position.
- The pilot may use violent and random elevator inputs causing secondary stall buffets and inefficient recovery from the stall.

??? ROLLS AND RETURNS

OBJECTIVES

- To develop a technique for recovering from very high bank angles as a prelude to upset recovery practice.
- To familiarize the pilot with high bank angles, developing self-confidence.
- To develop an awareness of G forces and the need for the smooth application of flight controls.

STANDARDS

- This is a training maneuver not to be checked.
- The pilot should be able to recover from the 135-degree bank smoothly without the use of violent inputs to the flight controls.

PREPARATION

- This maneuver should precede the RECOVERY FROM AN UPSET maneuver.

TECHNIQUES

- Begin the maneuver at about 10000 feet AGL so that the pilot is not over-concerned with the loss of altitude initially.
- In a clean configuration, have the pilot close the throttles to reduce the airspeed to maneuvering speed.
- To introduce the pilot to full aileron authority, have the pilot smoothly roll the aircraft to a 60-degree bank and return using full throw of the aileron only.
- To introduce the pilot to rudder authority, have the pilot smoothly apply full rudder to roll the aircraft a nominal amount and return to wings level using rudder only.
- Have the pilot rapidly roll (not necessarily with full throw) the aircraft to 90-degree bank and return to wings level using aileron only. Observe the amount that the nose drops.
- Again roll to and return from a 90-degree bank using aileron only to roll in and aileron with rudder to roll out. Observe the improved roll rate and the reduced amount that the nose drops.
- Do rolls and returns to higher bank angles using aileron to roll in and add rudder with aileron when rolling out.
- Observe the position of the bank index or "sky pointer" during the recovery to level flight. Point out that during the recovery the pilot is "stepping and rolling" toward the sky pointer.
- Discuss the need to ~~set~~ the wings in an NEAR upright and level position before pulling the nose up toward the horizon.
- Have the pilot recover the aircraft to an attitude of wings level and 15 degrees ANU.
- Emphasize the importance of smoothness with the flight controls and G load awareness.
- Have the pilot concentrate on recovering the attitude rather than using other devices such as speed brakes or landing gear.

•?? UPSET RECOVERIES

OBJECTIVES

- To gain experience in regimes of flight outside those normally experienced in airline operations.
- More specifically, to develop techniques for returning the aircraft to level flight once in an extreme high-bank, nose-up or nose-down attitude.

STANDARDS

- This is a training maneuver not a checking maneuver.
- The pilot in training must demonstrate an ability to recover from a simulator-induced or instructor-induced upset in a manner that would not damage the aircraft or injure the passengers or crew.

PREPARATION

- The ROLLS AND RETURNS maneuver should have been practiced prior to exposing the pilot-in-training to this maneuver.
- Until the simulator software has been created that will allow the instructor to induce the upset from the panel, the instructor will have to fly the attitude to the desired position using the flight controls.

TECHNIQUES

- To begin, practice should include an upset at low speed and an altitude high enough that a crash does not occur.
- Plan to induce two kinds of upsets; (1) an extreme bank angle which usually results in a very nose-down attitude, induced at clean maneuvering speed, and (2) an extreme nose-up position, entered from approximately 250 knots.
- Also plan to induce an upset at low altitude and at high altitude.
- For the techniques in recovering from a high bank angle, see the ROLLS AND RETURNS maneuver.
- For recovery from extreme nose-up attitudes, especially at low airspeed, demonstrate the technique of rolling the aircraft to a 90 degree bank to allow the nose to return to the horizon. If the speed is very slow, some bottom rudder can be helpful in getting the nose to start down.
- As the nose passes the horizon, have the pilot roll the wings level and pull the nose up only after sufficient speed has been recovered.
- At some point during high altitude training, it should be demonstrated that once the aircraft has gotten to very slow speed, it is impossible to regain cruise airspeed without losing altitude.
- A high altitude upset should be practiced at cruise airspeed emphasizing smoothness and G-load awareness using only aileron to control roll and elevator to control pitch. The pilot should be taught to pull throttles to idle to control excess speed. Caution should be exercised in the use of speed brakes or landing gear at very high speeds due to pitch-up and possible excessive G forces.

SAY "UPSET"

BRIEFING NOTES CONFIRM W/STANDBY

- Inadvertent upsets have occurred in the airline industry with catastrophic results.
- Techniques for recovery should be simple, effective and easy to remember.
- The ADI is the primary control instrument for recovery from an upset. Due to varying visibility conditions, one can not depend on having adequate outside visual references.

HIGH BANK ANGLE UPSET

- The nose drops during high bank angles in transport aircraft, especially at lower airspeeds.
- At low speed, large, smooth, non-violent control inputs are essential in obtaining the best performance from the aircraft when close to the ground. Smoothness with the flight controls with an awareness of G forces will assist in avoiding the accelerated stall and damage to the aircraft as well as injury to passengers and crew.
- The coordinated use of rudder when rolling out of a high bank greatly reduces the amount of nose drop and improves the roll rate, especially at low speed.
- An extreme nose-down attitude greatly reduces the amount of time available for recovery. Quickly ~~rolling~~ the aircraft toward the "sky pointer" on the ADI to ~~attain~~ WINGS wings level and then pulling the nose up carefully avoiding excessive G forces is an efficient technique for recovery.

HIGH-SPEED RECOVERY

- Gentleness with the flight controls, especially the elevator, is imperative at high speeds to avoid structural damage and injury to passengers and cabin crew, some of whom are almost always unbelted.
- At high speeds, the use of ailerons alone are all that is required in most cases to smoothly fly the aircraft back to an upright position from a high-bank or inverted attitude.
- Excessive G forces are far more damaging to the aircraft than excessive airspeed. If the aircraft reaches an extreme nose-down attitude, careful and smooth application of elevator alone is recommended for the recovery. It is important to remember that at very high speeds, the aircraft will pitch up with the deployment of the speed brakes and will do so even more with the lowering of the landing gear. Therefore, use care in avoiding excessive G forces in recovery.

EXTREME NOSE-UP ATTITUDE

- Unless the extreme nose-up attitude is corrected quickly, flight control effectiveness will be lost due to low airspeed.
- Rolling the aircraft into a high bank angle NOT TO EXCEED ~~approaching~~ 90 degrees will facilitate lowering the nose of the aircraft and reduce negative G forces while bringing the nose down. This technique is especially effective when the nose-up attitude is caused by an improper stabilizer trim position.
- UNLOAD ELEVATOR IF BUFFET OCCURS

USE OF THE AUTOPILOT

- The autopilot is incapable at slow speed of holding the correct attitude against an adverse yaw condition caused by an engine failure resulting in an upset. It is imperative that the pilot flying keep the aircraft in trim while flying with a single engine.
- Aircraft have been known to reach extreme bank angles in cruise due to an unnoticed autopilot failure.
- Holding elevator control forces against an engaged autopilot in attempt to help or overpower it can cause an upset. Holding elevator against the autopilot causes the autopilot to trim the stabilizer against the elevator input. Recovering from an upset caused by an inappropriate stabilizer trim position can be difficult to manage smoothly.
- If the aircraft becomes upset while the autopilot is engaged, it is highly recommended that the pilot disengage the autopilot before executing the recovery. Disengaging the autopilot while holding control forces may cause a sudden change in aircraft attitude resulting in damage or injury.

PROBLEMS

- Violent control inputs.
- Unwillingness to use large control inputs.
- Disorientation.

*?? ENGINE FAILURE AFTER Y2

OBJECTIVES

- To develop the pilot's ability to fly the airplane safely when an engine failure occurs while the aircraft is at low speed, at a high pitch attitude and near the ground such as immediately after takeoff or during a go-around.
- This maneuver is specifically designed to be simple and easy to remember preparing the pilot for the surprise encounter of the engine failure in a challenging regime of flight.
- The design of this maneuver counters the two most dangerous occurrences that can result from a surprise engine failure while the aircraft is in a very low-energy state; (1) the loss of airspeed and subsequent loss of flight control authority, and (2) the application of the incorrect rudder for the asymmetric thrust condition.

STANDARDS

- This is a training, not a checking, maneuver.
- The pilot should be able to put the aircraft in a pitch attitude that keeps the airspeed from falling below VMC for the asymmetric thrust condition with wings level without descending back into the ground.
- The pilot should be able to unerringly apply the correct rudder to bring the aircraft into coordinated flight. Heading is not an immediate primary concern in this maneuver.

PREPARATION

- Begin this maneuver with visual conditions selected. As the pilot gains experience and confidence, introduce instrument conditions.
- By using IP to return to takeoff position and repeating the maneuver, maximum training benefits can be obtained. (Remember to put the gear down in the B-767 sim before the IP.)

TECHNIQUES

- Teach the pilots to speak up immediately when an engine failure is recognized.
- Be sure the pilot does not hesitate in flying the aircraft to the target pitch attitude using the ADI as the primary instrument not the F/D.
- During the first try with this technique, have the pilot put and hold the wings in a level attitude using only the ailerons. Observe that this may require a large input but is possible if the airspeed is not allowed to decay to VMC. Observe that the yoke indicates which rudder should be applied.
- Make sure that the correct rudder is applied in a smooth, measured motion rather than a random, walking manner. Point out that the application of the correct rudder is a natural, coordinated control input. Emphasize the importance of not using any artificial means of determining the correct rudder such as looking at the engine instruments.
- Have the pilot use the VSI as the primary reference during the level-off but call for ALTITUDE HOLD so that the F/D does not mislead.
- Vary the place where engine failure occurs. For example, at the first thrust reduction or just as the attitude reaches the maximum pitch attitude.
- Vary the place where engine failure occurs. For example, at the first thrust reduction or just as the attitude reaches the maximum pitch attitude.
- Consider giving one of these maneuvers during the V1 practice sessions or during a go around.

BRIEFING NOTES

- Acknowledge the fact that there are many techniques that can be employed to safely fly the aircraft under the subject conditions. However, the following techniques are considered to be safe and efficient.
- Discuss the fact that this training is designed to prepare the pilot for the surprise event that likely will occur at a time when the pilot is least ready for it. The techniques suggested here are intentionally kept simple for that reason.
- Explain that the following techniques can be used for the engine failure during a go-around as well as immediately after takeoff or at any other low-energy regime of flight.
- Remind the pilot that most of the engine-failure training we have experienced has occurred at V1 on the runway. Although many of the principles used in that training still apply, these techniques differ from that training.
- Explain the danger of failing to put the pitch attitude in a position that will conserve the airspeed without descending back into the ground. Give the pilot a target pitch attitude (somewhere near 12.5 degrees, depending on weight).
- Explain the benefits of putting the wings in a level attitude using only aileron; (1) to provide maximum lift, and (2) to indicate, through the yoke position, which rudder requires application.
- After the correct rudder has been applied, the pilot should level the aircraft at or above 500 feet AGL or the appropriate altitude for the conditions. Since the engine has failed after much inertia has been established, the aircraft will most likely have little difficulty reaching 500 feet AGL and may have already exceeded that altitude. The most accurate flight instrument for the level-off is the VSI rather than the F/D. However, the pilot should call for ALTITUDE HOLD so that the F/D does not mislead.
- After the level-off has been accomplished, the aircraft should be safely flown to the appropriate heading.
- The remainder of the maneuver should be managed in the same way as the traditional ENGINE FAILURE AT V1 maneuver.
- Review the suggested priority of actions used with this technique:

  (1) NOSE TO ABOUT 12.5 DEGREES.
  (2) WINGS LEVEL WITH AILERON.
  (3) CORRECT RUDDER (SEE YOKE).
  (4) LEVEL OFF (VSI).
  (5) TURN TO APPROPRIATE HEADING.
  (6) ACCELERATE AND CLEAN UP.

PROBLEMS

- Failure to recognize the engine failure.
- Failure to fly the pitch to the target attitude.
- Failure to hold the wings level.
- Failure to ascertain and apply the correct rudder.
- Rough or random control inputs.

*?? AUTOPILOT OVERRIDE DEMONSTRATION

OBJECTIVES

- To demonstrate the inadvisability of attempting to hand-fly the airplane while the autopilot is engaged.
- To demonstrate how the autopilot will trim the stabilizer while elevator pressure is held.
- To allow the aircraft to become upset with an extreme nose-up attitude at high altitude leading to a recovery maneuver.

STANDARDS

- The pilot should be able to recover from the upset without violent or unnecessary control inputs or causing the aircraft to be over stressed by too-rapid elevator inputs or secondary stalls.

PREPARATION

- Should be given only after training with UPSET RECOVERIES has been given.

TECHNIQUES

- Recommend the altitude be above FL330.
- With the autopilot engaged, in altitude hold, autothrottle engaged, push forward on the yoke to hold the pitch to 10 degrees below the horizon.
  - Observe that the autopilot eventually trims against the pressure held.
  - Once stabilizer trim has reached approximately 8 units (5 units for 767), smoothly release the control pressures and allow the autopilot to pitch the aircraft nose up.
- Observe that the autopilot usually continues to trim the stabilizer further.
- Once the nose of the aircraft has reached approximately 30 degrees up or more, have the pilot roll the aircraft to 90 degrees bank to allow the nose to fall below the horizon before rolling the wings level.
- Be sure that the pilot recovers the aircraft attitude without violent control inputs or over-stressing the aircraft.

BRIEFING NOTES

- Discuss how the autopilot will react to control inputs by the pilot while it is engaged.
- Emphasize the benefits of disengaging the autopilot before pilot inputs are made.
- Discuss the proper technique for recovering from an extreme pitch-up. (see UPSET RECOVERIES maneuver techniques)
- Emphasize the importance of gentle but deliberate elevator inputs at high speed in avoiding excessive G forces.
- Recommend also against using rudder with autopilot engaged as when operating with a single engine because of the possibility of causing an upset.
- If for any reason flight control inputs are required, disengage the autopilot

PROBLEMS

- Random, violent or excessive control inputs, especially with the elevators.

*?? HIGH-SPEED DEMONSTRATION

OBJECTIVES

- To demonstrate the pitch-up moment cause by the extension of the landing gear or speed brake at high speed.
- To develop an awareness of the slow turn rate of an airplane operating at high speed.

STANDARDS

- This is a training maneuver.

PREPARATION

TECHNIQUES

- Recommend that the airspeed be near YMO during this demonstration.
- Quickly extend the speed brake at YMO while the aircraft is being hand flown and observe the pitch-up.
- Extend the landing gear while at YMO while the aircraft is being hand flown and observe the pitch-up.
- Turn the aircraft using a 30-degree bank and observe the slow turn rate.

BRIEFING NOTES

- Discuss the pitch-up resulting from the deployment of either the speed brake or landing gear at high speed and the danger of over-stressing the aircraft when using these devices during an upset recovery.
- Discuss the rate of turn of aircraft at high speed.
- Discuss the importance of following TCAS climb or descend commands rather than attempting to turn the aircraft to avoid another airplane.
- Discuss the importance of planning a large turn radius when navigating through thunderstorms or terrain at high speed.

PROBLEMS

*?? YMC DEMONSTRATION ON AUTOPILOT

OBJECTIVES

- To stress the importance of keeping the aircraft trimmed while in a single-engine condition.
- To stress the importance of keeping adequate speed while in a single-engine condition.
- To teach the recognition of and the recovery from the upset resulting from allowing the aircraft speed to fall below the autopilot's single-engine minimum control speed (YMC) while the autopilot is engaged.
- To demonstrate the difficulty involved in recovering airspeed without the loss of altitude.

STANDARDS

- This is a training maneuver. The pilot should be able to recover from the resulting upset when the condition is induced at approximately 2000 feet AGL.

PREPARATION

- It is suggested that this maneuver be demonstrated only after the pilot-in-training has practiced with the ROLLS AND RETURNS and RECOVERY FROM AN UPSET maneuvers.

TECHNIQUES

- With a single engine operating, establish the airplane at about 2000 feet AGL, with flaps 5, at maneuvering speed, with autopilot engaged, fully trimmed.
- Have the pilot the close the throttle to lose airspeed.
- Observe that, as the airspeed decays, the autopilot first holds a bank angle in an attempt to control the heading.
- As the airspeed decays further, the autopilot reaches its YMC and the airplane rolls uncontrolled toward the failed engine.
- Observe that there are no aurel warnings or lights lights to indicate that the autopilot has lost control of the aircraft.
- Observe further that the autopilot remains engaged throughout the resulting upset.
- After the aircraft has reached a sufficiently impressive upset attitude, have the pilot disengage the autopilot and recover.
- Observe the difficulty experienced in attempting to regain airspeed and that there is a point at which one must trade altitude for airspeed.
- Stress the importance of taking special care during single-engine operations to maintain the airspeed at or above the maneuvering speed for the configuration and for keeping the aircraft in trim on a continual basis, throughout the flight, all the way to landing.

BRIEFING NOTES

- Discuss the fact that when we use the autopilot there is a tendency to relax somewhat and that we must guard against failing to monitor the flight of the aircraft.
- Discuss the need for keeping the aircraft trimmed continually during all single-engine operations but especially during speed, power or configuration changes.
- Point out that only two axes are controlled when we operate with one autopilot engaged.
- Recommend against operating with more than one autopilot engaged, using three-axis control, during single-engine operations because the aircraft is never in trim when doing so and, if the aircraft is inadvertently returned to a single-autopilot operation in an out-of-trim condition, then an upset might occur.
- Discuss the proper method of keeping the aircraft trimmed during single-engine operations with the autopilot engaged.
- Discuss the fact that a single autopilot is capable of holding an attitude during single-engine operations if the aircraft is kept in trim. However, if the rudder is not trimmed and the airspeed drops below a certain speed, the autopilot will not be able to hold the wings level.
- Point out that the autothrottle is not operative during single-engine operations.
- Stress the importance of paying closer-than-usual attention to the airspeed during single-engine operations because, if the aircraft is allowed to get slow enough, the only way the airspeed can be regained is by losing altitude and, if the aircraft is too low, there will not be sufficient altitude to trade for airspeed. Many aircraft have been lost this way!

PROBLEMS

- Pilot is unable to recover from the upset before flying into the ground.

*?? SINGLE-ENGINE APPROACH ON AUTOPILOT

OBJECTIVES

- To develop proper techniques for executing a coupled approach and hand-flown missed approach with an engine inoperative.
- To stress the need for keeping the aircraft in trim and at an adequate airspeed while operating with a single engine.

STANDARDS

- This is a training maneuver only.
- Normal tolerances for category I ILS approach.

PREPARATION

- Recommend using weather approximating category I minimums.

TECHNIQUES

- This procedure can be included in the regular single-engine practice maneuvers.

BRIEFING NOTES

- Since crews have been trained to hand-fly the single-engine approach for evaluation purposes, some aspects of this technique must be discussed.
- Discuss the fact that this is a useful technique for executing an approach in very low visibility conditions.
- Stress that this procedure does NOT recommend an autoland with a single engine.
- Stress the need for using one autopilot rather than multiple autopilots so that the aircraft might be kept in trim throughout the approach and during the hand-flown missed approach.
- Stress the need for keeping the aircraft on speed especially at low altitude. This is particularly important since the crews are used to relying somewhat on the autothrottle in maintaining the desired airspeed. (see SINGLE-ENGINE YMC WITH AUTOPILOT ENGAGED demonstration).
- Discuss the need for following the autopilot's actions, staying continuously ready to hand-fly by keeping hands and feet on the flight controls while the autopilot flies.
- Caution the pilots not to attempt to apply flight control inputs while the autopilot is engaged. Rather, advise them that if control inputs are required, disengage the autopilot and fly.
- To execute a missed approach, disengage the autopilot first then fly.

PROBLEMS

- Failure to keep the aircraft in trim.
- Failure to keep the aircraft on speed.

*?? EMERGENCY QUICK RETURN

OBJECTIVES

- To develop awareness and techniques for returning to the airport in the shortest possible time under emergency conditions such as an uncontrollable fire.

STANDARDS

- This is an awareness and training maneuver.

PREPARATION

TECHNIQUES

- This maneuver might work best in visual conditions.

BRIEFING NOTES

- Discuss the various possible flight patterns for returning to the airport in the shortest time under various visibility conditions.
- Point out that after takeoff, one must use radio information to determine how far away from the airport the aircraft is. Therefore, having one VOR tuned to a local facility can be useful.
- Discuss how knowing the geometry of the airport layout can be useful when choosing a runway in a hurry.
- Have the pilots consider using 330 feet per nautical mile as a reference in managing altitude while maneuvering to return to land
- Discuss the minimum actions required in getting the aircraft back on the ground quickly under extreme emergency conditions:

(1) ADVISE TOWER, GET CLEARANCE.
(2) PERFORM IMMEDIATE ACTIONS.
(3) SELECT FLAPS, APPROACH SPEED.
(4) CAREFUL WITH SPEED, ALTITUDE.
(5) ADVISE F/As, ON PA.
(6) GEAR DOWN
(7) COMMUNICATE WITH TOWER.

PROBLEMS

- Allowing the aircraft to venture unnecessarily far from the airport.
- Forgetting to accomplish one of the necessary items.
- Failure to manage altitude appropriately for distance from the runway.

*?? SPEED BRAKE WITH LANDING CONFIGURATION DEMONSTRATION

OBJECTIVES

- To develop an ability to recognize cues that the speed brake is still deployed while the aircraft is in the landing configuration on final approach.

STANDARDS

- This is a training demonstration.

PREPARATION

TECHNIQUES

- Recommend that this demonstration be given along with the maximum angle of descent demonstration (gear down, flaps 30, speed brake out, minimum ground speed).
- IP the simulator to short final approach. Configure the aircraft with gear down and full flaps and the speed brake deployed at reference airspeed plus 5 knots.
- Observe and discuss the cues that warn the pilot that the speed brake is deployed inappropriately.
- Once cues are discussed, retract the speed brake and observe the pitch changes that result from doing so. Point out that caution should be exercised in retracting the speed brake near the ground.
- Recommend that the PIT not be allowed to land the aircraft with the speed brake deployed, since a successful landing may lead to a false sense of security and a lack of regard for the dangers in doing so.

BRIEFING NOTES

- Discuss the technique of attaining the maximum angle of descent with the gear down, flaps 30, speed brake deployed and minimum ground speed.
- Stress that the speed brake can be forgotten on final approach and the importance of developing methods of remembering such as keeping a hand on the handle when it is being used.
- Discuss the catastrophic consequences that can result from landing with the speed brake deployed.
- Point out cues that warn of a forgotten speed brake which will include:

(1) A nose-up attitude of approximately 10 degrees versus the normal 2 to 3 degrees.
(2) The pitch limit indicator near the attitude of the aircraft at this speed.
(3) The associated caution light on the glare shield and the EICAS message can be cancelled but the forward panel light remains lit.
(4) There will be more difficulty maintaining the glide slope and approach speed than normal. This cue may not be noticed if the approach is being flown on autopilot or with autothrottle on.

PROBLEMS

?? CROSS-CONTROL MANEUVERING

OBJECTIVES

- To gain or refresh an understanding of the relationship between heading, track and heading bug as presented on the HSI instrument.
- To demonstrate the rudder and aileron control authority of the B-757/767 aircraft.
- To practice with and develop a full understanding of the cross-control maneuver as used for crosswind landings.

STANDARDS

- This is a training and diagnostic maneuver.
- The pilot must demonstrate a complete understanding of the HSI presentation as well as an ability to cross control the aircraft in a precision manner.

PREPARATION

- This maneuver will require a 30-knot crosswind for the heading flown while doing the part of the maneuver where the pilot is required to bring heading and track together over the heading bug.
- The instructor should be aware that while the aircraft is held in a cross-control attitude, the wind symbol presented on the HSI will be in error. However, the simulator crosswind will still be effective in separating the heading and track as long as it is applied across the heading.

TECHNIQUES

- With flaps up, have the pilot fly the aircraft at maneuvering speed.
- Have the pilot display the MAP mode on the HSI.
- Demonstrate the use of rudder only to control bank.
- Have the pilot apply full rudder smoothly while holding the wings level with aileron and altitude with the elevator. Observe that sufficient aileron authority remains to provide roll against a full throw of the rudder at maneuvering speed.
- While holding the rudder in and the wings level, observe the heading pointer moving across the scale of the expanded compass rose.
- While he/she still holds the rudder, have the pilot make the track be still on the compass rose by using aileron.
- Install a 30-knot wind. Using normal coordinated controls, ask the pilot to turn the *aircraft to a heading 90 degrees to the wind* symbol on the HSI. Observe whether the pilot turns to the heading or to the track.
- Have the pilot turn the aircraft so that the track is superimposed over the heading bug.
- Now ask the pilot to use the flight controls in whatever way necessary to superimpose the heading, track and heading bug. The pilot will have to use rudder to control heading and aileron to control track. Have him/her do this while holding altitude and speed.

BRIEFING NOTES

- A brief review of the HSI presentation of heading, track and heading bug is recommended.

PROBLEMS

- Poor scan.
- Lack of understanding of HSI presentation.
- Lack of proficiency or understanding of the use of aileron and rudder during precision cross-control maneuvering which could lead to difficulties with crosswind landings.

??? HIGH-ALTITUDE ENGINE FAILURE

OBJECTIVES

- To develop the flight crew's ability to manage the difficulties caused by either an engine failure or the shutting down of an engine while the aircraft is above the maximum engine-out cruise altitude.
- This procedure can be used during any high-altitude operation, not necessarily just ETOPS.

STANDARDS

- The crew must manage the loss of thrust, properly controlling the airplane attitude, speed, driftdown and navigation clear of traffic and terrain.
- The crew must successfully complete the Flight Handbook Emergency Procedure.
- The issuance of an effective distress message is part of this procedure.

PREPARATION

- This procedure should be practiced at a very high altitude with a gross weight that challenges the crew to move quickly and accurately through the procedure. Recommend FL390 or above.
- Reduced outside visibility is recommended.
- Be sure that the airplane is being flown on the autopilot in YNAY simulating a cruise condition for maximum realism.

TECHNIQUES

- Having the crew on headsets, in communication with ATC, assists with realism, especially when the crew issues a distress message and requests a clearance.
- An engine flameout is useful in demonstrating the possible insidious nature of the loss of thrust.
- Be sure to notice whether the crew correctly manages keeping the aircraft in trim throughout the procedure. It is preferred that the autopilot remain engaged unless the aircraft has been upset and that the pilot trims the rudder without applying rudder pedal inputs. Discuss the use of the yoke to point to the correct rudder trim requirements.
- Teach the importance of navigating clear of traffic, terrain and adverse weather throughout the procedure and the need for continual monitoring of the flight path of the airpane.
- Make sure that proper attention is given to the issuance of an effective distress message. Allow the pilots the opportunity to practice saying the distress message.

BRIEFING NOTES

- This procedure is appropriate for any high-altitude arena, airway or oceanic route.
- Discuss the importance of developing a personal disipline of monitoring the engines in order to notice a silent engine failure.
- This procedure is to be used for any condition requiring the shutting down of an engine at altitudes that will require an immediate descent, whether it be for emergency, irregular or precautionary reasons. Therefore the immediate actions involved will differ depending on the reason for the engine shutdown.
- Discuss the fact that this procedure acts as an organized approach to a complex management problem. Therefore, it is recommended that the pilot-in-command not function as the pilot flying in order to allow maximum effort be given to the management and cross-checking duties.
- This procedure calls for the execution of other procedures with a return to this procedure.
- It is suggested that, unless conditions dictate otherwise, the pilot flying allow the airplane to remain on autopilot to maximize the cross-checking capability of the PF.
- If still on autopilot, rudder trim alone should be employed by the PF referencing the yoke displacement. Rudder pedal inputs should not be used unless the airplane is being handflown.
- For traffic avoidance reasons, the procedure calls for descending the airplane initially at the ENG-OUT speed obtained from the CRZ page of the CDU. Later the procedure calls for a driftdown performance assessment by the Captain.
- Because an off-track turn will probably be required during the descent, the navigation of the airplane clear of traffic, terrain and weather will require monitoring by both pilots during this procedure. This brings up the importance of continually keeping in mind the appropriate diversion plan while in cruise.
- Discuss and practice the features of an effective distress message. Stress the use of MAYDAY to get attention and clear the frequency and speaking slowly and deliberately to allow copying the message.
- Discuss the importance of finishing the appropriate procedures associated with the engine shutdown.

PROBLEMS

- Failure to notice the engine failure until the aircraft performance is degraded to a dangerous level.
- The use of rudder inputs while on autopilot causing possible upset of the airplane attitude.
- Failure to establish appropriate driftdown performance for the airplane under the conditions.
- Failure to make the appropriate traffic and terrain avoidance and diversion course corrections.
- Issuing a random, hurried or disorganized distress message.
- Failure to complete the necessary procedures including making provisions for the completion of the SINGLE ENGINE APPROACH AND LANDING checklist.

HIGH-ALTITUDE ENGINE FAILURE/SHUTDOWN

Condition: Engine failure, flameout or abnormal engine indications necessitate engine shutdown, with airplane above engine-out maximum altitude and requiring an immediate descent and traffic avoidance maneuver.

Action:
- The PIC on the flight deck assigns PF duties to the SIC at the beginning of the procedure so that the PIC can more effectively coordinate activities and communications.
- Unless conditions dictate otherwise, the autopilot should remain engaged during this procedure.

IMMEDIATE ACTION

A/T ARM SWITCH ..... OFF

THRUST, GOOD ENGINE ONLY ..... MAX CONTINUOUS

THRUST, AFFECTED ENGINE ..... IDLE

If engine fire, severe damage, or separation:

APPROPRIATE EMERGENCY PROCEDURE, IMMEDIATE ACTIONS ONLY ..... ACCOMPLISH

RUDDER ..... TRIM

CDU CRZ PAGE, ENG OUT PROMPT ..... SELECT, EXECUTE

MCP ALTITUDE ..... SET ENG OUT MAX ALTITUDE

MCP FLCH SWITCH ..... PUSH, SET ENG OUT SPEED

DIVERSION AIRPORT ..... DETERMINE

If heading change required:

MCP BANK LIMIT ..... SELECT 15

MCP DESIRED HEADING ..... SELECT, PUSH
- ETOPS – turn 90° off track, then parallel.
- High terrain – turn away or follow escape routing.

REFERENCE ACTION

CAUTION

Airplane attitude, trim, performance and navigation must be carefully managed throughout this procedure.

(Continued)

HIGH ALTITUDE ENGINE FAILURE/SHUTDOWN (Continued)

APU (IF AVAILABLE) ..... START

EXTERIOR LIGHTS ..... ON

TRANSPONDER 7700

POSITION AND TIME ..... RECORD

DISTRESS MESSAGE ..... INITIATE

Repeat "MAYDAY–MAYDAY–MAYDAY" as necessary to establish uninterrupted communications. Speak slowly and deliberately to allow recipients to comprehend and copy the distress message. The message must include at a minimum the following:
- Flight number and type aircraft
- Nature of distress
- Current altitude, position, and time
- Assistance requested

ATC CLEARANCE ..... OBTAIN

NAVIGATION ..... ESTABLISH

Use the appropriate navigational aids to establish the new route.

APPROPRIATE ENGINE EMERGENCY OR SHUTDOWN PROCEDURE ..... ACCOMPLISH

Accomplish the reference items of the appropriate engine procedure, then return to this procedure.

If restarting the engine is to be attempted:

INFLIGHT ENGINE START PROCEDURE ..... ACCOMPLISH

Return to this procedure whether or not the restart is successful.

DRIFTDOWN PERFORMANCE AND ALTITUDE CAPABILITY ..... DETERMINE

Establish the appropriate airspeed and descent performance for existing circumstances.

NOTE

The Captain must continually re-evaluate the suitability of the diversion airport and the aircraft's performance. Constant communication must be maintained with all necessary personnel, including airborne intercept if necessary. Periodic and frequent position recordings and reports are required.