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PARALLEL RUNWAY REQUIREMENT ANALYSIS STUDY

Volume 2 - Simulation Manual

Y.S. Ebrahimi and K.S. Chun

BOEING COMMERCIAL AIRPLANE GROUP
Seattle, Washington

Contract NAS1-18027
December 1993

National Aeronautics and
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1.0 SUMMARY

This document is a user manual for operating the PLAND_BLUNDER (PLB) simulation program. This simulation is based on two aircraft approaching parallel runways independently and using parallel Instrument Landing System (ILS) equipment during Instrument Meteorological Conditions (IMC). If an aircraft should deviate from its assigned localizer course toward the opposite runway, this constitutes a *blunder* which could endanger the aircraft on the adjacent path. The worst case scenario would be if the blundering aircraft were unable to recover and continue toward the adjacent runway. PLAND_BLUNDER is a Monte Carlo-type simulation which employs the events and aircraft positioning during such a *blunder situation.*

The model simulates two aircraft performing parallel ILS approaches using Instrument Flight Rules (IFR) or visual procedures. PLB uses a simple movement model and control law in three dimensions (X, Y, Z). The parameters of the simulation inputs and outputs are defined in this document along with a sample of the statistical analysis.

This document is the second volume of a two volume set. Volume 1 is a description of the application of the PLB to the analysis of close parallel runway operations.

2.0 INTRODUCTION

2.1 BACKGROUND

One of the major aviation problems in recent years has been the steady increase in the number and duration of flight delays. Airports have been unable to keep pace with traffic growth. A main component of these flight delays has been the capacity constraints placed on the current configuration of most airports. While this problem can best be solved by increasing airport capacity via constructing new airports and runways, few programs of this type are currently underway or even planned. With more efficient use of existing fixed airport resources, however, some modest changes in airport geometry can be made to better accommodate traffic. Therefore, during the past few years the FAA has initiated an airport capacity program designed to provide additional capacity at existing airports. Some of the improvements in this program include new Air Traffic Control (ATC) procedures, terminal automation, additional instrument landing systems, improved controller display aids, improved utilization of multiple runways, and improved airport and pavement design.

One of these improvements concerns parallel runway landings. Many airports have more than one runway to allow aircraft to land or depart from multiple runways. Controllers rely on the pilot's visual separation when runways are close together and weather conditions are good (i.e., as aircraft approach each other, the controller points out each aircraft to the pilot of the other aircraft and requires that the pilots maintain a safe spacing), and rely on radar to maintain a much larger spacing between aircraft when visibility is low (i.e., the pilots cannot be expected to maintain *safe spacing*). The capacity of an airport with multiple runways is less in IMC than in visual conditions. The amount of decreased capacity is dependent upon the spacing between runways.

Two controllers in the Terminal Approach Control Facility (TRACON) monitor traffic when conducting *simultaneous, independent parallel approaches* during instrument meteorological conditions. Each controller is assigned to monitor the traffic to one runway. The airspace between the runways is divided into three zones: the two Normal Operating Zones (NOZ) centered on the extended runway centerline representing the airspace needed to contain the normal approach tracks of all aircraft using the runway, and the No Transgression Zone (NTZ) in the middle representing the area that is normally kept free of aircraft. (Parallel runway approach zones are shown in *Figure 1*.)

Currently, the criterion is a separation of 4,300 ft or more between parallel runways for conducting independent instrument approaches. This standard was established based on the surveillance rate and accuracy of the Airport Surveillance Radars (ASR) and terminal Automated Radar Tracking System (ARTS) capabilities.

However, subsequent analysis has indicated that the separation between parallel runways could be reduced if the surveillance data rate and accuracy were improved. Surveillance and display technology are now available which should allow operations to be conducted on parallel runways separated by less than 4,300 ft.

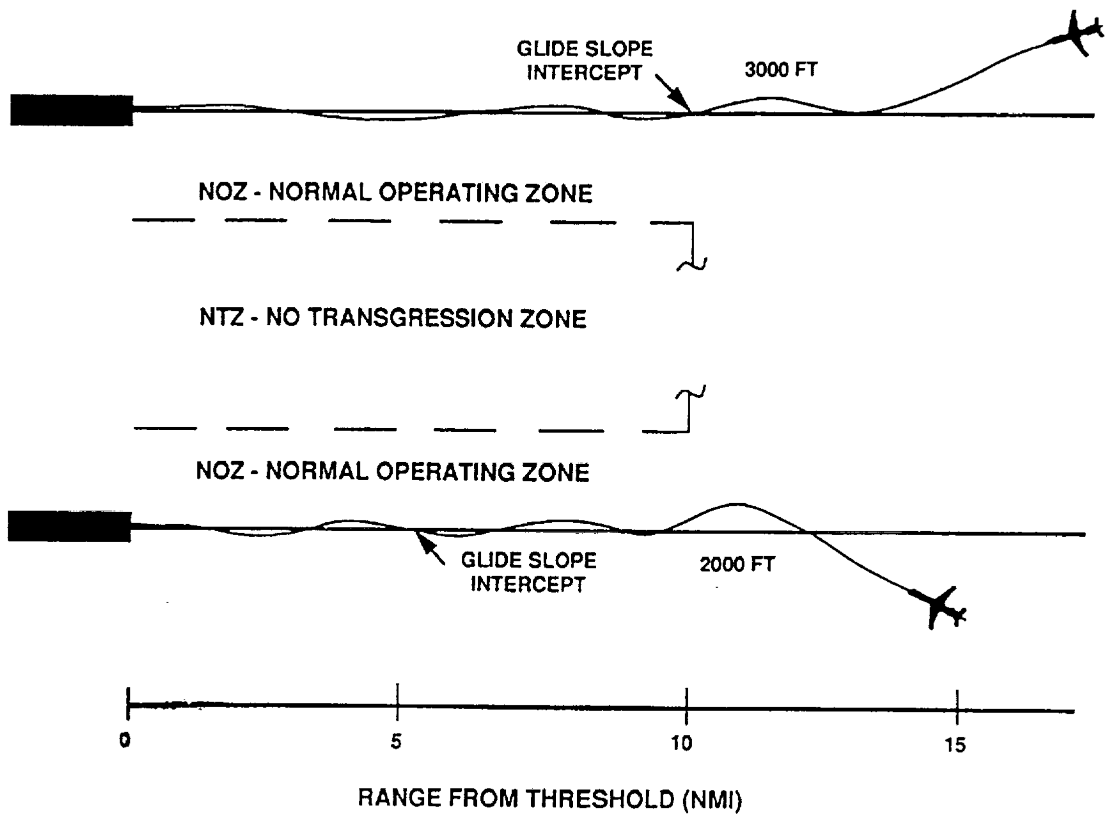

Figure 1. Parallel Runway Approach Zones

Present procedures provide 1,000 ft of vertical separation between aircraft during the time that the aircraft are turning onto and capturing the final approach course guidance. The aircraft normally maintain this vertical separation until intercepting the glideslope associated with their respective approach paths. Once the aircraft start their descent and the vertical separation is lost, the monitor controllers must assure that any penetration of the NTZ results in an appropriate control action to assure aircraft separation.

When runways are spaced between 2,500 ft and 4,300 ft apart, the controller must employ dependent parallel approach procedures which require that a spacing of at least 1.5 nm be maintained from aircraft approaching the adjacent runway. This spacing constraint means that an airport without the requisite spacing between runways suffers a capacity penalty of about 40% during IMC.

2.2 PRECISION RUNWAY MONITOR SYSTEM

Significant capacity gains can be achieved where closely spaced parallel runways exist by implementing the Precision Runway Monitor (PRM) system. This system consists of controller procedures and new equipment (i.e., radar and controller display). The PRM system is driven by an improved radar sensor. The PRM program is intended to improve runway acceptance and departure rates so that operations under instrument conditions more closely approximate those achievable in visual conditions.

The 4,300-foot separation standard (based on a 1981 Mitre Corporation requirement analysis) is the amount of time it might take an aircraft that has strayed from its approach course to traverse the area between the two parallel approach courses. Hence, the closer the runways and courses, the less time controllers have to rectify a potentially hazardous situation (i.e., termed a *blunder*). A blunder occurs when an aircraft begins to cross over toward the other approach course. A blunder can be rectified by the controllers first seeing it occur on the radar and then reacting to it by issuing an instruction to one or both aircraft. The pilots must then hear the instruction, and adjust the controls of the aircraft to respond. Finally, the aircraft itself must respond to the pilot's commands to get the aircraft heading away from the potential collision. When all these response times are added up, 20 to 30 sec can elapse between the beginning of a blunder (i.e., where two aircraft are beginning to converge) until the aircraft are redirected and begin to diverge.

The PRM program has been demonstrated at Memphis International and Raleigh-Durham airports (runway geometry shown in *Figure 2*) and designed to reduce two of these reaction times by three fold: the time it takes the radar to display a blunder, and the time it takes the controller to see it on the display and react to it. Conventional airport surveillance radars update the target position every 4 to 5 sec. If it is assumed that it takes two scans for the controller to detect a problem on a radar with a 5 sec update rate, then 10 sec will elapse before the controller issues an instruction to the pilot. If it is further assumed that a blundering aircraft moves toward the adjacent runway at 120 ft/sec, then that same 10 sec radar update delay could result in a loss of 1,200 ft. Put another way, each second of improvement in the update rate results is a reduction in allowable runway spacing of 240 ft.

Aside from the update rate, additional time can be saved with a more accurate radar and an improved controller display. Such refinements (i.e., the symbol portraying the aircraft on the display being smaller and the deviations from the on-course track being easier-to recognize) will allow a controller to be certain of a blunder occurring and declare it earlier. Further computer processing of the track will allow for the generation of an automated alert which will lessen the reaction time of the controller.

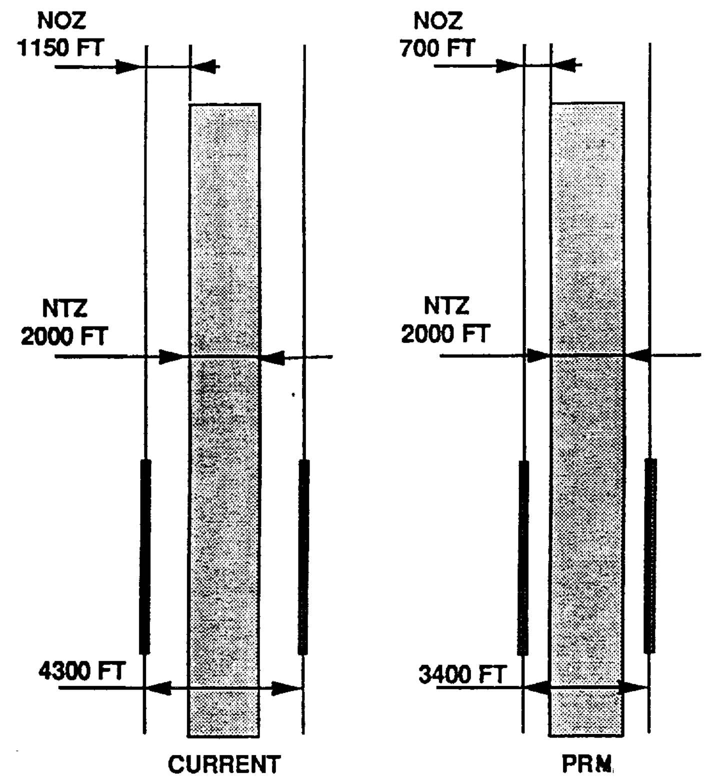

Figure 2. Normal Operating Zone Shrinks as Runway Separation is Reduced

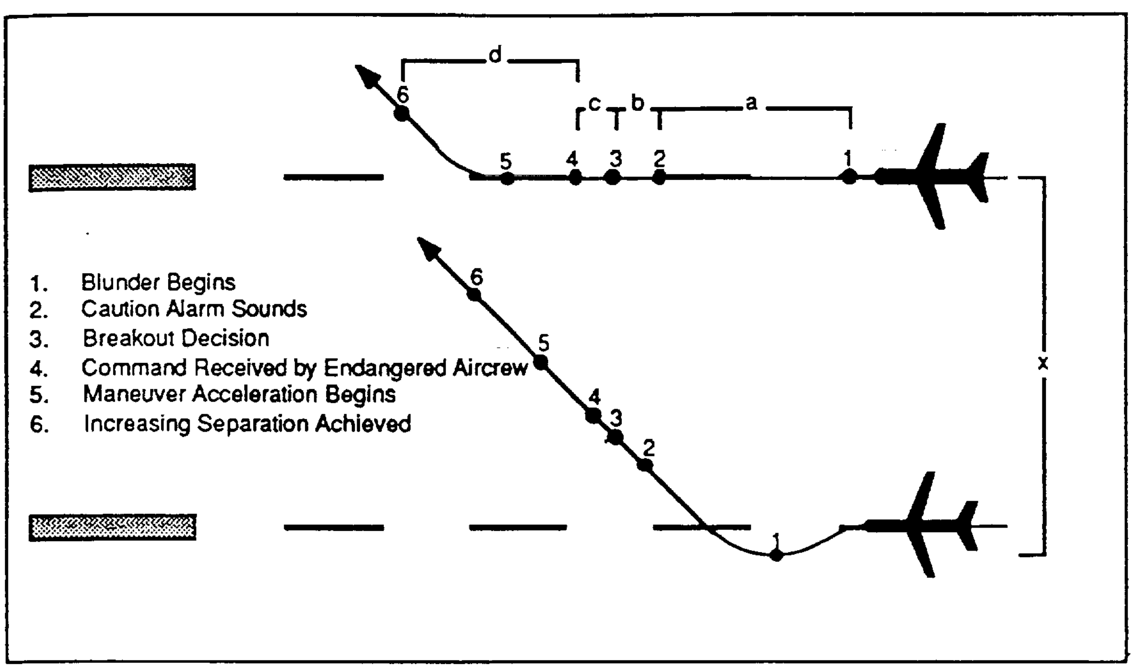

Figure 3. Blunder-Model Event Sequence

Furthermore, if a blunder should occur, then satisfactory resolution of that blunder requires that the evader aircraft be turned away in time to avoid a collision with the blundering aircraft. The amount of time available depends on several elements which characterize the performance of aircraft, air traffic control equipment, and their human operators. These elements can be understood from *Figure 3,* which shows a schematic diagram of a blunder. The elements are:

1. The time used by the sensor to detect the blunder and generate an alarm.

2. The time used by the monitor controller to recognize the alarm, decide whether a breakout instruction is needed, and determine when to issue the instruction.

3. The time required to communicate the instruction to the pilot of the endangered aircraft.

4. The time required for the aircraft crew to recognize the instruction and give the control inputs, and for the aircraft to respond to the control inputs and maneuver to the point where the separation between the aircraft is increasing.

5. The lateral distance between the two aircraft at the start of the blunder.

2.3 PLAND_BLUNDER SIMULATION PROGRAM

Two streams of aircraft approach the parallel runways independently of one another during independent parallel Instrument Landing System (ILS) approaches. If one aircraft deviates from its assigned localizer towards the opposite runways, there could be an endangered (evader) aircraft in its path. A deviation from the parallel approach towards the opposite runway constitutes a blunder. The worst case scenario would be for the blundering aircraft to be unable to recover (i.e., returning to the assigned approach) and continue toward the adjacent stream of aircraft. PLAND_BLUNDER (PLB) is a Monte Carlo-type fast simulation of the events and aircraft position during a worst case blunder situation. This model simulates two aircraft performing parallel ILS approaches using Instrument Flight Rules (IFR) or visual procedures with one aircraft blundering and the other possibly reacting to avoid the blunderer. PLB uses a very simple movement model and control law in three dimensions (X, Y, Z).

2.3.1 INPUT(S) OF SIMULATION PARAMETERS

The input parameters include: runway geometry, aircraft class, approach speed of aircraft, general type of blunder, general type of reaction, near miss criteria, and number of Monte Carlo cases to run. Some of the randomly influenced parameters are: initial along-track distance between aircraft, angle of blunder, location of blunder, time to detect blunder, time to react by controller, time to react by pilot, aircraft response delay, and aircraft class.

2.3.2 ASSUMPTIONS AND LIMITATIONS

The movement model assumes the bank and pitch angles are decoupled and instantaneous. Turns are modeled as constant radius and level. There is no energy modeling of altitude, speed, and turning. The aircraft is assumed to follow the nominal profile plan with no minor adjustments to course, altitude and speed. There is no flight control system to react to perturbations or changes. The runways are assumed to be exactly parallel and level. Only the part of the approach after turn-on is modelled. The aircraft position update interval is .5 second. Each run is terminated 50 sec after the evasion maneuver starts, since it is assumed that the closest approach will have occurred before then. A blunder is considered to have occured when either the alarm distance from the centerline or the edge of the NTZ is breached by the blundering aircraft. The alarm distance and the NTZ edge are set equal for IMC runs, whereas only the alarm distance defines a blunder for VMC runs.

2.3.3 OUTPUT OF SIMULATION

The standard output of PLB is the **1_run_single_line** records file (**run_rec.track**). This describes each trial run as a one line summary of initial conditions and the results. Optional outputs are the tracks files (**AC_1.track, AC_2.track** and **RUN_1.track**). These track files record time-stamped data describing the movement of each aircraft in detail.

3.0 SYMBOLS AND ABBREVIATIONS

AC	Aircraft
ARTS	Automated Radar Tracking System
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
FAA	Federal Aviation Administration
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Condition
NOZ	Normal Operating Zone
NTZ	No Transgression Zone
OS	Operating System
PLB	PLAND_BLUNDER Simulation Program
PRM	Precision Runway Monitor
RWY	Runway
SD	Standard Deviation
TAE	Total Azimuth Error
TRACON	Terminal Approach Control Facility
WP	Way Point

4.0 RUNNING THE PROGRAM

4.1 SOFTWARE INSTALLATION AND INFORMATION TO BUILD PLB SIMULATION

The main source files are *FORTRAN 77* with extension **.f** and employ files with extensions **.inc** and **.use**. All these files must be in the same working directory. The build scripts are for the *UNIX SYSTEM5 OS.*

To compile and link the simulation, type: **pland.blunder.make**
To compile and link the statistics, type: **pland.stat.make**

The simulation uses a random number generator. At Boeing this is available in library /tech/bin/bcslib and the routines are called *HSRSUN* and *HSRSNR*. Outside Boeing these routines should be replaced by their equivalents. Changes should be made in *FORTRAN* file random.f and to the **pland.blunder.make** script.

4.2 INPUT FILES

The input file to the PLB simulation is in a command file: **pland_exec.dat**. *Table 1* shows a sample **pland_exec.dat** File.

4.2.1 OVERVIEW OF COMMANDS FOR THE PLB SIMULATION

A command interpreter extracts scenario definitions and run parameters from the commands.

Necessary definitions for a PLB simulation run are:

1. *Aircraft (AC) profiles 1 and 2* - Use a **AC_CASE** command for each aircraft.

2. *Aircraft (AC) types (1-6)* - Use a **AC_TYPE** command for each type used.

3. *Runway geometries 1 and 2* - Use a **RWY_DEF** command for each runway, or a **RWY_PAIR** command to define both.

4. *Number of trials run with same inputs* - Use a **RUN_X** command after other items are defined.

5. *QUIT command* - Use a **QUIT** command to signal the end of input.

Table 1. Sample PLAND_EXEC.DAT Input File

```
! Comment:  Sample command file to show most capabilities without massive output data.

******************* AC TYPE SEGMENT *********************
! Comment:  Define aircraft types and fleetmix.
AC_TYPE 4  SIZE 230.0 200.0  70.0 Tresponse  3.0  1.0  SPD 1,2 m+SD 170.0 10.0 140.0  5.0   kts
>>>     ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD  -2.0   5.0
AC_TYPE 1  SIZE  50.0  60.0  30.0 Tresponse  2.0  1.0  SPD 1,2 m+SD 110.0 10.0  80.0  5.0   kts
>>>     ESC ACEL,CLMB m+SD 30.0 10.0 30.0 10.0  TAE ANGLE(mR) m+SD  -3.0  10.0
AC_TYPE 2  SIZE 100.0 100.0  50.0 Tresponse  2.0  1.0  SPD 1,2 m+SD 140.0 10.0 110.0  5.0   kts
>>>     ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD  -2.0   7.0
AC_TYPE 3  SIZE 150.0 160.0  60.0 Tresponse  3.0  1.0  SPD 1,2 m+SD 160.0 10.0 130.0  5.0   kts
>>>     ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD  -2.0   5.0
FLEETMIX (1-6)  10.0  20.0  30.0  40.0   0.0   0.0
ALT_FMIX (1-6)  10.0  20.0  30.0  40.0   0.0   0.0

******************* PROFILE SEGMENT *********************
! Comment:  Define the blunder and escape profiles for the aircraft.
AC_CASE BLUNDER_1  AC 1  TYPE 0  RWY L  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>     dTURN  3.0 Dblund hi,lo 60761.0 60761.0  BLUND m+SD ANG  30.0  1.0 SLOPE  0.0  1.0 DV  0.0 10.0
AC_CASE NORM_ESC_1 AC 2  TYPE 9  RWY R  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>     BANK m+SD 60.0  0.0  HEAD  50.0 CLIMB/ACCEL BY TYPE

******************* RUNWAY GEOMETRY SEGMENT *********************
! Comment:  Define runway geometry.
RWY_DEF  R  THRESH    0.0    CENTERLINE,NOZ   -2150.0   1150.0
RWY_DEF  L  THRESH    0.0    CENTERLINE,NOZ   -2150.0   1150.0

******************* RESPONSE TIME SEGMENT *********************
! Comment:  Define alarm criteria and response delay times..
ALARM     Dalarm  300.0
RESPONSE SENSOR GAUSSIAN    3.0    1.0
RESPONSE ATC    DISTR_FILE study.0.ATC.dat
RESPONSE COM    GAUSSIAN    1.5    0.5
RESPONSE PILOT  GAUSSIAN    4.0    1.0
******************* RUNX SEGMENT *********************
! Comment:  Define the range of x-offset geometries and the number of runs.
STEP_T   Tmin,max,step    -3.0    3.0    2.0
RUN_X        3     SEED     7000000
QUIT
```

Optional definitions for PLB simulation run are:

1. *Delays for response times* - Use a **DELAYS** command to define response delay times. (Default is 0 delay.)

2. *Fleetmixes for random aircraft* - Use a **FLEETMIX** or **ALT_MIX** command.

3. *Offset time limits and step size* - Use a **STEP_T** command. (Default is using the **Tstart** data from the AC_CASE commands.)

4. *Single run tracks turned on* - Use a **TRACKS** command. (Default is no tracks files.)

4.2.1.1 DEFINITION OF COMMANDS AND PARAMETERS

The definitions of commands and parameters for the different commands are listed in *Appendix A* which can be used as a Reference Manual.

4.2.2. DESCRIPTION OF PROFILES

The final segment of the flight will be divided into two parts, distinguished by two different speeds for each aircraft, to create *Parallel ILS approach scenarios.* This will then support the PRM scenarios of approximately 10 and 2 miles from the runway threshold. For *dual parallel runway ILS approaches,* there are three possible aircraft profiles (i.e., AC-CASE):

1. **NORMAL_1**
(Example: AC_CASE NORMAL_1 AC 1 TYPE 4 RWY L Dstart 50000.00 Tstart m+SD 10.0 5.0)

   NORMAL_1 follows a straight course down the runway centerline with touchdown at runway threshold. Aircraft type, runway assignment and speed for each Way-Points (WPs) are explicitly defined as:

   Start to WP 1: glideslope = -3
   speed = speed_1 (random) for this AC_TYPE

   WP 1 to WP 2: glideslope = -3
   speed = speed_2 (random) for this AC_TYPE

2. **NORM_ESC_1**
(Example: AC_CASE NORM_ESC_1 AC 2 TYPE 4 RWY R Dstart 70000.0 Tstart m+SD 0.0 0.0 BANK m+SD 60.0 0.0 HEAD 50.0 CLIMB/ACCEL BY TYPE)

NORM_ESC_1 follows the same course as NORMAL_1, until a collision avoidance command is given. The avoidance response is a turn away and climb. The aircraft type is explicitly defined as:

Start to WP 1: glideslope = -3
speed = speed_1 (random) for this AC_TYPE

WP 1 to WP 2: glideslope is determined by type-dependent climb rate

where WP 2 is touchdown (speed = old_speed + type-dependent speed increase).

When the avoidance command is given the aircraft will turn away with BANK (random) until the course (HEAD) is established. Then the aircraft will straighten out and climb, and alter speed after the turn is completed.

3. BLUNDER_1
(Example: AC_CASE BLUNDER_1 AC 1 TYPE 3 RWY L Dstart 70000.0 Tstart m+SD 0.0 0.0 dTURN 3.0 Dblunder hi, lo 60761.0 60761.0 BLUNDER m+SD ANG 30.0 1.0 SLOPE 0.0 1.0 DV 0.0 10.)

BLUNDER_1 follows the same course as NORMAL_1 until the distance Dblunder (random) from the threshold is reached. The blunder can occur either before or after WP 1. The blunder is a change to a new heading and a new glideslope.

From start to WP 1: WP 1 is blunder point	glideslope = -3 speed = speed_1 (random) for this AC_TYPE
From WP 1 to WP 2: WP 2 is 10,000 ft past threshold	glideslope = specified glideslope (random) speed = speed_2 (random) for this AC_TYPE
when blunder point reached:	turn toward other runway with dTURN deg/sec till blunder-angle (random) reached, then straighten out and assume new glideslope (random), add DV to speed.

4.2.3 INTERPRETATION OF INPUT FILE

Each element comprising the Input File is defined here using *Table 1* as a reference.

4.2.3.1 AIRCRAFT TYPES AND FLEETMIX

AC_TYPE 4

AC_TYPE 4	Aircraft type definition for Type 4.
SIZE 230.0 200.0 70.0	Aircraft type dimension in ft: x = 230, y = 200, z = 60. (This type represents a Boeing 747 whose data is currently not being used by the simulation.)
Tresponse 3.0 1.0	Aircraft type time to respond to pilots control inputs, mean=3, standard deviation (SD) = 1 sec.
SPD 1, 2 m+SD 170.0 10.0 140.0 10.0	Aircraft type Speed1 and Speed2. Speed1 is faster, used further from runway, mean = 170, SD = 10 kn. Speed2 is slower, used closer to runway, mean = 140, and SD = 5 kn.
>>> ESC ACEL, CLMB m+SD 30.0 10.0 40.0 10.0	This is the second line of the AC_TYPE command defining the aircraft type, speed change and climb rate during collision avoidance maneuver. Speed change occurs instantaneously after the maneuver turn is complete. Speed change mean = 30 and SD = 10 fps. Climb rate is constant and applied after the maneuver turn is complete. Climb rate mean = 40 and SD = 10 fps.
TAE ANGLE (mR) m+SD -2.0 5.0	Aircraft offset or Total Azimuth Error (TAE) (flight technical error, radar error, etc.) crosstrack angle toward NTZ from runway centerline at threshold, mean=-2.0 and SD = 5.0 mR.

AC_TYPE 1, 2, 3

AC_TYPE 1, 2, 3 etc.	Aircraft type definition for Types 1, 2 and 3. The data follows the same format as for type 4. Types 5 and 6 are currently undefined and are available for expansion.

FLEETMIX (1-6)

FLEETMIX (1-6) 10.0 20.0 30.0 40.0 0.0 0.0	Fleetmix aircraft type percentage definition for random aircraft types: aircraft Type 1 is 10%, Type 2 is 20%, Type 3 is 30%, type 4 is 40%, Types 5 and 6 are 0%, total is 100%.
ALT_FMIX (1-6) 0.0 0.0 30.0 20.0 30.0 20.0	Same definition as above (optionally one Fleetmix used for Blunderer and the other for evader).

4.2.3.2 RUNWAY GEOMETRY

RWY_DEF R

RWY_DEF R	Runway definition for right side runway.
THRESH 0.0	Threshold is at x = 0 and is not used.
CENTERLINE, NOZ 2150.0 1150.0	Runway centerline is at y = 2150 with NOZ extending 1,150 ft. on both sides.

RWY_DEF L

RWY_DEF L	Runway definition for left side runway.
THRESH 0.0	Threshold is at x = 0 and is not used.
CENTERLINE, NOZ -2150.0 1150.0	Runway centerline is at y =-2150 with NOZ extending 1,150 ft. on both sides.

Together these definitions define runway separation (rwy sep) = 4,300 ft and NTZ = 2,000 ft.

4.2.3.3 DEFINE ALARM CRITERIA

ALARM

Dalarm 300.0	The alarm criteria is 300 ft from extended runway centerline to start delay timers.

4.2.3.4 RESPONSE DELAY TIMES

RESPONSE DELAYS	Delay definitions with *delays* simulating response times for various systems.
RESPONSE SENSOR	This defines the sensor system response.to initiate yellow alarm.
GAUSSIAN 3.0 1.0	This system has a *Gaussian* distribution for response time, with mean Delay =3.0 and SD=1.0 sec.
RESPONSE ATC	Controller time to interpret alarm and send instructions.
DISTR_FILE study_D.ATC.dat	This system's response time is defined by a cumulative distribution defined in file study_D.ATC.dat. The other option is, to define controller response time in the form of a *Gaussian* distribution with a mean and standard deviation.
RESPONSE COM	The ATC communication response time. A *Gaussian* distribution with a mean and standard deviation. The other option is, to define the communication response time in the form of a distribution.
PILOT 4.0 1.0	Pilot time to interpret instruction and move flight controls (mean delay = 4.0 sec. and SD= 1.0 sec). The other option is, to define the controller response time in the form of a *Gaussian* distribution with a mean and standard deviation.
AC_TYPE()	Comment reminding user that the aircraft type has a delay that's not set here

4.2.3.5 BLUNDER AND ESCAPE PROFILES FOR AIRCRAFT

AC_CASE

AC_CASE	Aircraft case or profile definition that defines general behavior of aircraft.
BLUNDER_1	Use BLUNDER_1 profile which turns to a constant blunder angle.
AC 1	This is for aircraft #1.
TYPE 0	Aircraft Type 0 indicates random type based on fleetmix percentages.
RWY L	Use left runway.
Dstart 70000.0	Start the simulated approach at 70,000 ft from the threshold.
Tstart m+SD 0.0 0.0	Start moving at time 0. This is over-ridden by STEP_T command.
>>> dTURN 3.0	Second line: The turn rate of the blunderer during the blunder is 3 deg/sec.
Dblund hi, lo 60761.0 60761.0	The blunder occurs 60,761 ft. (10 nm) from threshold.
BLUND m+SD ANG 30.0 10.0	Blunder angle which is the turn from course by the blunderer (mean = 30 and SD =1 deg).
SLOPE 0.0 1.0	Slope flown by blunderer after the blunder (mean = 0 and SD = 1 deg).
DV 0.0 10.0	Speed change by blunderer after the blunder (mean = 0 and SD = 10 fps).

AC_CASE

AC_CASE	Aircraft case or profile definition which defines the general behavior of aircraft.
NORM_ESC_1	Use NORM_ESC_1 profile to fly the approach normally until it gets a message to avoid blunderer, then it fly escape maneuver by turning to a given heading and climbing

AC 2	This is for Aircraft #2.
TYPE 3	Aircraft Type 3.
RWY R	Use right runway.
Dstart 70000.0	Start the simulated approach 70,000 ft from the threshold.
Tstart m+SD 0.0 0.0	Start moving at time 0. This is over ridden by STEP_T command.
>>> BANK m+SD 60.0 0.0	Second line: Define escape maneuver bank angle (mean = 60 and SD = 0 deg).
HEAD 50.0	Define escape maneuver heading to 50 deg away from other runway.
CLIMB/ACCEL BY TYPE	This is a comment stating that the escape maneuver climb rate and speed change are based on aircraft type (3).

4.2.3.6 RANGE OF X-OFFSET GEOMETRIES AND NUMBER OF RUNS

STEP_T

STEP_T	Define iteration of trials varying time offsets. (Offset is between AC 1 and AC 2 start times in seconds.)
Tmin, max, step -3.0 3.0 2.0	Time offset steps from -3 to 3 sec at 2 sec intervals. (This could be set at -32 to 32 sec at 1 sec intervals, representing -1.5 to 1.5 nm at 287 fps.)

RUN-X

RUN_X 3	Define number of trials to run with the same time offsets. (This combined with the STEP-T will run 3 x 4 = 12 trials.)
SEED 7000000	Define initial random number seed.

QUIT

Quit	End of the simulation

4.3 RUNNING PBL SIMULATION

To run PLB simulation, type: **pland_exec.exe.** After entering this command the program will read the input file from *pland_exec.dat*. Then after the execution, the output will be stored under different files.

4.4 PLB SIMULATION OUTPUTS

The PLB simulation always creates a 1_run_single_line output file **run_rec.track**. Optionally, the simulation also creates *tracks* files showing time-stamped data for each run. The *tracks* files are turned on with the TRACKS command in the input file. These files can be extremely long for Monte-Carlo runs with large sample sizes. The *tracks* files are: **AC_1.track, AC_2.track,** and **RUN.track.**

The simulation also generates output in the shell output window. This output is not used for analysis, but is useful to verify the program is running.

4.4.1 run_rec.track OUTPUT FILE

The complete **run_rec.track** output file is listed in *Table B1* of *Appendix B*. The header and the first two data lines are shown in *Table 2(a-e)*.

*Table 2a. Sample **run_rec.track** Standard Output File for Aircraft 1 Profile*

PROFILE#1	RWY	TYPE	Dstrt#1	Tstrt#1	v1#1	v2#1	data1#1	data2#1	data3#1
BLUNDER_1	L	4	70000.0	3.0	293.0	225.5	293.0	30.3	1.1
BLUNDER_1	L	4	70000.0	3.0	297.2	234.9	297.2	30.7	-0.5

|----------aircraft 1 profile definition for this trial-----------------|

*Table 2b. Sample **run_rec.track** Standard Output File for Aircraft 2 Profile*

PROFILE#2	RWY	TYPE	Dstrt#2	Tstrt#2	v1#2	v2#2	data1#2	data2#2	data3#2
NORM_ESC_1	R	3	70000.0	0.0	260.0	198.7	60.0	47.4	288.3
NORM_ESC_1	R	3	70000.0	0.0	262.9	192.7	60.0	46.7	314.7

|------------aircraft 2 profile definition for this trial------------------|

*Table-2c. Sample **run_rec.track** Standard Output File for Trial Results*

ERRCODE	AVOID	COLLIDE	Tresp	Dmiss.shad	Dmiss
0	T	F	15.5	536.7	1247.4
0	T	F	20.2	2904.1	2904.1

|-------------trial results---------------|

Each data line in *Table 2a-c* represents one simulation trial in which the parameters of the trial and results are summarized. Each aircraft profile is described as defined by the randomly drawn and nonrandom parameters for that trial. The data columns are defined as:

1. **PROFILE #1** - Aircraft 1 profile type name.

2. **RWY** - Aircraft 1 assigned runway.

3. **TYPE** - Aircraft 1 aircraft type.

4. **Dstrt #1** - Aircraft 1 starting distance from the runway threshold.

5. **Tstrt #1** - Aircraft 1 movement starting time.

6. **v1#1** - Aircraft 1 speed 1, the faster speed used further from the runway.

7. **v2#1** - Aircraft 1 speed 2, the slower speed used closer to the runway.

8. **data1#1** - Aircraft 1 profile-dependent data item 1 (see Table 2d for translation).

9. **data2#1** - Aircraft 1 profile-dependent data item 2 (see Table 2d for translation).

10. **data3#1** - Aircraft 1 profile-dependent data item 3 (see Table 2d for translation).

11. **PROFILE#2** - Aircraft 2 information given in the same format as for Aircraft 1.

12. **ERRCODE** - Simulation error code with 0 meaning no error (see Table 2e for translation.

13. **AVOID** - Flag set true if an avoidance maneuver was attempted.

14. **COLLIDE** - Flag set true if the two aircraft got within 500 feet of each other.

15. **Tresp** - Total response delay time from the aircraft violating the blunder criteria until the other aircraft starts its avoidance maneuver.

16. **Dmiss.shad** - Closest approach distance between the two aircraft when there is no evasion maneuver.

17. **Dmiss** - Closest approach distance between the two aircraft.

The key to interpreting the parts of the 1_run_single_line output file are in *Table 2* with the key to interpreting the **data1**, **data2**, and **data3** outputs being in *Table 2d* and the key to interpreting the error code numbers (final code=prime multiplied) being in *Table 2e*.

*Table 2d. **data1, data2, and data3** Interpretation*

PROFILE NAME	data1	data2	data3
BLUNDER_1	DISTblunder	ANGblunder	SLOPEblunder
NORMAL1	0.0	0.0	0.0
NORM_ESC_1	BANK	CLIMB	SPEED

Table 2e. Error Code Numbers Interpretation

ERROR NAME	CODE #
no errors or warnings	0
rand draw, blunder_angle < 0, blunder turns away	3
rand draw, DISTblunder < 0	5
rand draw, DISTblunder > DISTstart	7
rand draw, BANK < 0, escaping AC turns toward	11
rand draw, Tsensor < 0	13
rand draw, Tatc < 0	17
rand draw, Tresponse < 0	19
rand draw, Tpilot < 0	23

4.4.2 AC_1.track OUTPUT FILE

The **AC_1.track** output file describes the state of Aircraft 1 after each timestep of the trial. Each data line describes one timestep. (Note:The complete output file **AC_1.track** has been listed in *Table B2* in *Appendix B.*) The header and the first two data lines are shown in *Table 3*.

*Table 3. Sample of **AC_1.track** Output File*

TI	RWY_lisL	X1	Y1	Z1	LEG1	HEAD1	V1	BANK1	SLOPE1
1.0	1	-70000.0	-2150.0	3668.5	1	0.0	293.0	0.0	-3.0
2.0	1	-70000.0	-2150.0	3668.5	1	0.0	293.0	0.0	-3.0

The data columns in *Table 3* are defined as:

1. **T1** - Time after simulation trial start (in seconds).
2. **RWY_1isL** - Runway assignment (where 1 is L and 2 is R).
3. **X1** - X location (in feet).
4. **Y1** - Y location (in feet).
5. **Z1** - Z location (in feet).
6. **LEG1** - Current waypoint leg (where LEG1 = 1 means heading toward the first waypoint).
7. **HEAD 1** - Heading (in degrees clockwise from runway centerline).
8. **V1** - Speed/total 3D ground speed (in ft/sec).
9. **BANK1** - Bank angle (in degrees right).
10. **SLOPE 1** - Glide slope (in degrees up).

4.4.3 AC_2.track OUTPUT FILE

The **AC_2.track file** describes the state of Aircraft 2 after each timestep of the trial with the headers and data columns of the file being analogous to those of the **AC_1. track** output file. (Note: The complete output file **AC_2.track** has been listed in *Table B3* of *Appendix B*.) The header and the first two data lines are shown in *Table 4*.

*Table 4. Sample of **AC_2.track** Output File*

T2	TWY_2isR	X2	Y2	Z2	LEG2	HEAD2	V2	BANK2	SLOPE2
1.0	2	-69740.0	2150.0	3654.9	1	0.0	260.0	0.0	-3.0
2.0	2	-69479.9	2150.0	3641.3	1	0.0	260.0	0.0	-3.0

4.4.4 RUN.track OUTPUT FILE

The **Run.track** output file describes the relationship between the two aircraft after each timestep of the trial with each data line describing one timestep. (Note: The complete **RUN.track** output file is listed in *Table B4* of *Appendix B*.) The header and the first two data lines are shown in *Table 5*.

*Table 5. Sample of **RUN.track** Output File*

TO	DISTshad	DISTshad_MIN	DIST	DIST_MIN	CLOSING_RATE
0.5	5308.0	5308.0	5308.0	5308.0	26.1
1.0	5295.0	5295.0	5295.0	5295.0	25.9

The data columns are defined as:

1. **TO** - Current time (in seconds).

2. **DIST** - Distance between AC 1 and AC 2 (in feet).

3. **DIST_MIN** - Minimum DIST so far in this trial (in feet).

4. **CLOSING_RATE** - Rate of change in distance between AC 1 and AC 2 (in ft/sec).

4.5 ANALYSIS OF DATA OUTPUT

After generating output files, the data can be analyzed and interpreted. The statistics programs used here is called STATS. *Figure 4* shows the flow diagram of PLB program from setting up the input file to statistical analysis and plotting of the output data.

4.5.1 STATISTICAL ANALYSIS OF OUTPUT DATA

The statistics counting program STATS describes the distribution of miss-distances of the Monte-Carlo simulation trials. STATS reads the 1-run-per-line output file **run_rec.track** and counts each miss distance, putting each trial into a bin based on miss distance. The output is designed to be read by a plotting packaging. Several lines of the header are instructions to the BOEING PEGASUS plot package and can be removed or ignored. The output file is **stats.stat**. with output columns of:

1. **LO** - Lower bound of bin/miss distance (in feet).

2. **HI** - Upper bound of bin/miss distance (in feet).

3. **HITSper** - Proportion of trials with miss distance in this bin.

4. **HITSn** - Number of trials with miss distance in this bin.

5. **HITSper_cum** - Proportion of trials with miss distance in this bin or less.

6. **HITSn_cum** - Number of trials with miss distance in this bin or less.
A sample of a **stats.stat** output file is shown in *Table 6* with a plot of **stats.stat** presented in *Figure 5*.

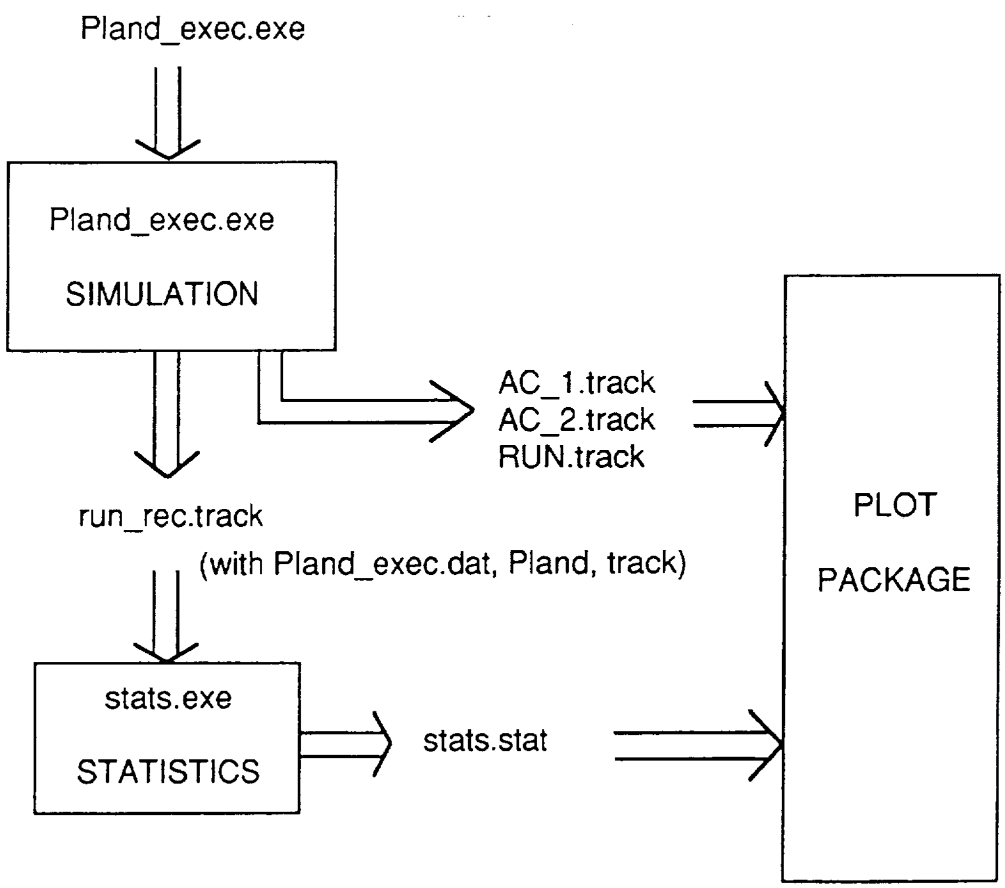

Figure 4. PBL Flow Diagram

Table 6. stats.stat Output File

RUNWAY SPACING OF 3400FT WITH 2000FT NTZ

```
! Comment:  Define aircraft types and fleetmix.
! Comment:  MITRE_type : AC_TYPE correlation (1:1  2:2  3:3  4:-  5:-  6:-  7:4  8:5  9:6)
AC_TYPE 1  SIZE 100.0 100.0  50.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 150.0 1.78 100.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 33.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
AC_TYPE 2  SIZE 100.0 100.0  50.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 150.0 1.78 110.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 17.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
AC_TYPE 3  SIZE 100.0 100.0  50.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 150.0 1.78 110.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 25.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
AC_TYPE 4  SIZE 230.0 200.0  70.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 180.0 1.78 140.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 33.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
AC_TYPE 5  SIZE 230.0 200.0  70.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 180.0 1.78 140.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 42.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
AC_TYPE 6  SIZE 230.0 200.0  70.0 Tresponse  0.0  0.0  SPD 1,2 m+SD 180.0 1.78 140.0 1.78   kts
>>>      ESC ACEL,CLMB m+SD  0.0  0.0 50.0  0.0  FTE ANGLE(mR) m+SD  -1.0   3.0
FLEETMIX (1-6)    9.0    5.7    5.3  21.0  43.0  16.0

! Comment:  Define the blunder and escape profiles for the aircraft.
AC_CASE BLUNDER_1  AC 1   TYPE 0  RWY L  Dstart  65000.0  Tstart m+SD   0.0  0.0
>>>      dTURN  3.0 Dblund hi,lo 60761.0 60000.0  BLUND m+SD ANG  30.0  0.0 SLOPE -3.0  0.0 DV  0.0  0.0
AC_CASE NORM_ESC_1 AC 2  TYPE 0  RWY R  Dstart  65000.0  Tstart m+SD   0.0  0.0
>>>      BANK m+SD 22.0  0.0  HEAD  55.0 CLIMB/ACCEL BY TYPE

! Comment:  Define runway geometry.
RWY_PAIR  SEP 3400.0  NTZ 2000.0

! Comment:  Define alarm criteria and response delay times
ALARM     Dalarm  340.0

RESPONSE SENSOR GAUSSIAN    5.0    5.0
RESPONSE ATC    GAUSSIAN    0.0    0.0
RESPONSE COM    GAUSSIAN    0.0    0.0
RESPONSE PILOT  GAUSSIAN    0.0    0.0

! Comment:  Define the range of x-offset geometries and the number of runs.
! Comment:  Evader ranges from 2500 ahead to 3500 feet behind blunderer.
STEP_DX  DXmin,max,step  -2500.0   3500.0    250.0
RUN_X        4     SEED     9876543
QUIT
```

*ESA
run1
*FLOAT

LO	HI	HITSper	HITSn	HITSper_cum	HITSn_cum
0.0	100.0	0.0000	0	0.0000	0
100.0	200.0	0.0000	0	0.0000	0
200.0	300.0	0.0100	1	0.0100	1
300.0	400.0	0.0100	1	0.0200	2
400.0	500.0	0.0200	2	0.0400	4
500.0	600.0	0.0000	0	0.0400	4
600.0	700.0	0.0100	1	0.0500	5
700.0	800.0	0.0000	0	0.0500	5
800.0	900.0	0.0300	3	0.0800	8
900.0	1000.0	0.0000	0	0.0800	8
1000.0	1100.0	0.0100	1	0.0900	9
1100.0	1200.0	0.0100	1	0.1000	10
1200.0	1300.0	0.0400	4	0.1400	14
1300.0	1400.0	0.0100	1	0.1500	15
1400.0	1500.0	0.0100	1	0.1600	16
1500.0	1600.0	0.0500	5	0.2100	21
1600.0	1700.0	0.0600	6	0.2700	27
1700.0	1800.0	0.0400	4	0.3100	31
1800.0	1900.0	0.0300	3	0.3400	34
1900.0	2000.0	0.0200	2	0.3600	36
2000.0	2100.0	0.0600	6	0.4200	42
2100.0	2200.0	0.0300	3	0.4500	45
2200.0	2300.0	0.0800	8	0.5300	53
2300.0	2400.0	0.0200	2	0.5500	55
2400.0	2500.0	0.0600	6	0.6100	61

*Table 6. **stats.stat** Output File (Concluded)*

2500.0	2600.0	0.0400	4	0.6500	65
2600.0	2700.0	0.0400	4	0.6900	69
2700.0	2800.0	0.0500	5	0.7400	74
2800.0	2900.0	0.0100	1	0.7500	75
2900.0	3000.0	0.0300	3	0.7800	78
3000.0	3100.0	0.0400	4	0.8200	82
3100.0	3200.0	0.0100	1	0.8300	83
3200.0	3300.0	0.0300	3	0.8600	86
3300.0	3400.0	0.0400	4	0.9000	90
3400.0	3500.0	0.0000	0	0.9000	90
3500.0	3600.0	0.0200	2	0.9200	92
3600.0	3700.0	0.0100	1	0.9300	93
3700.0	3800.0	0.0000	0	0.9300	93
3800.0	3900.0	0.0200	2	0.9500	95
3900.0	4000.0	0.0000	0	0.9500	95
4000.0	4100.0	0.0000	0	0.9500	95
4100.0	4200.0	0.0100	1	0.9600	96
4200.0	4300.0	0.0000	0	0.9600	96
4300.0	4400.0	0.0100	1	0.9700	97
4400.0	4500.0	0.0100	1	0.9800	98
4500.0	4600.0	0.0100	1	0.9900	99
4600.0	4700.0	0.0100	1	1.0000	100
4700.0	4800.0	0.0000	0	1.0000	100
4800.0	4900.0	0.0000	0	1.0000	100
4900.0	5000.0	0.0000	0	1.0000	100
5000.0	5100.0	0.0000	0	1.0000	100
5100.0	5200.0	0.0000	0	1.0000	100
5200.0	5300.0	0.0000	0	1.0000	100
5300.0	5400.0	0.0000	0	1.0000	100
5400.0	5500.0	0.0000	0	1.0000	100
5500.0	5600.0	0.0000	0	1.0000	100
5600.0	5700.0	0.0000	0	1.0000	100
5700.0	5800.0	0.0000	0	1.0000	100
5800.0	5900.0	0.0000	0	1.0000	100
5900.0	6000.0	0.0000	0	1.0000	100
6000.0	6100.0	0.0000	0	1.0000	100
6100.0	6200.0	0.0000	0	1.0000	100
6200.0	6300.0	0.0000	0	1.0000	100
6300.0	6400.0	0.0000	0	1.0000	100
6400.0	6500.0	0.0000	0	1.0000	100
6500.0	6600.0	0.0000	0	1.0000	100
6600.0	6700.0	0.0000	0	1.0000	100
6700.0	6800.0	0.0000	0	1.0000	100
6800.0	6900.0	0.0000	0	1.0000	100
6900.0	7000.0	0.0000	0	1.0000	100
7000.0	7100.0	0.0000	0	1.0000	100
7100.0	7200.0	0.0000	0	1.0000	100
7200.0	7300.0	0.0000	0	1.0000	100
7300.0	7400.0	0.0000	0	1.0000	100
7400.0	7500.0	0.0000	0	1.0000	100
7500.0	7600.0	0.0000	0	1.0000	100
7600.0	7700.0	0.0000	0	1.0000	100
7700.0	7800.0	0.0000	0	1.0000	100
7800.0	7900.0	0.0000	0	1.0000	100
7900.0	8000.0	0.0000	0	1.0000	100
8000.0	8100.0	0.0000	0	1.0000	100
8100.0	8200.0	0.0000	0	1.0000	100
8200.0	8300.0	0.0000	0	1.0000	100
8300.0	8400.0	0.0000	0	1.0000	100
8400.0	8500.0	0.0000	0	1.0000	100
8500.0	8600.0	0.0000	0	1.0000	100
8600.0	8700.0	0.0000	0	1.0000	100
8700.0	8800.0	0.0000	0	1.0000	100
8800.0	8900.0	0.0000	0	1.0000	100
8900.0	9000.0	0.0000	0	1.0000	100
9000.0	9100.0	0.0000	0	1.0000	100
9100.0	9200.0	0.0000	0	1.0000	100
9200.0	9300.0	0.0000	0	1.0000	100
9300.0	9400.0	0.0000	0	1.0000	100
9400.0	9500.0	0.0000	0	1.0000	100
9500.0	9600.0	0.0000	0	1.0000	100
9600.0	9700.0	0.0000	0	1.0000	100
9700.0	9800.0	0.0000	0	1.0000	100
9800.0	9900.0	0.0000	0	1.0000	100
9900.0	10000.0	0.0000	0	1.0000	100
10000.0	99999.9	0.0000	0	1.0000	100

```
*EOD
   TOTALn=       100
```

RUNWAY SPACING OF 3400FT WITH 2.4 UPDATE RATE

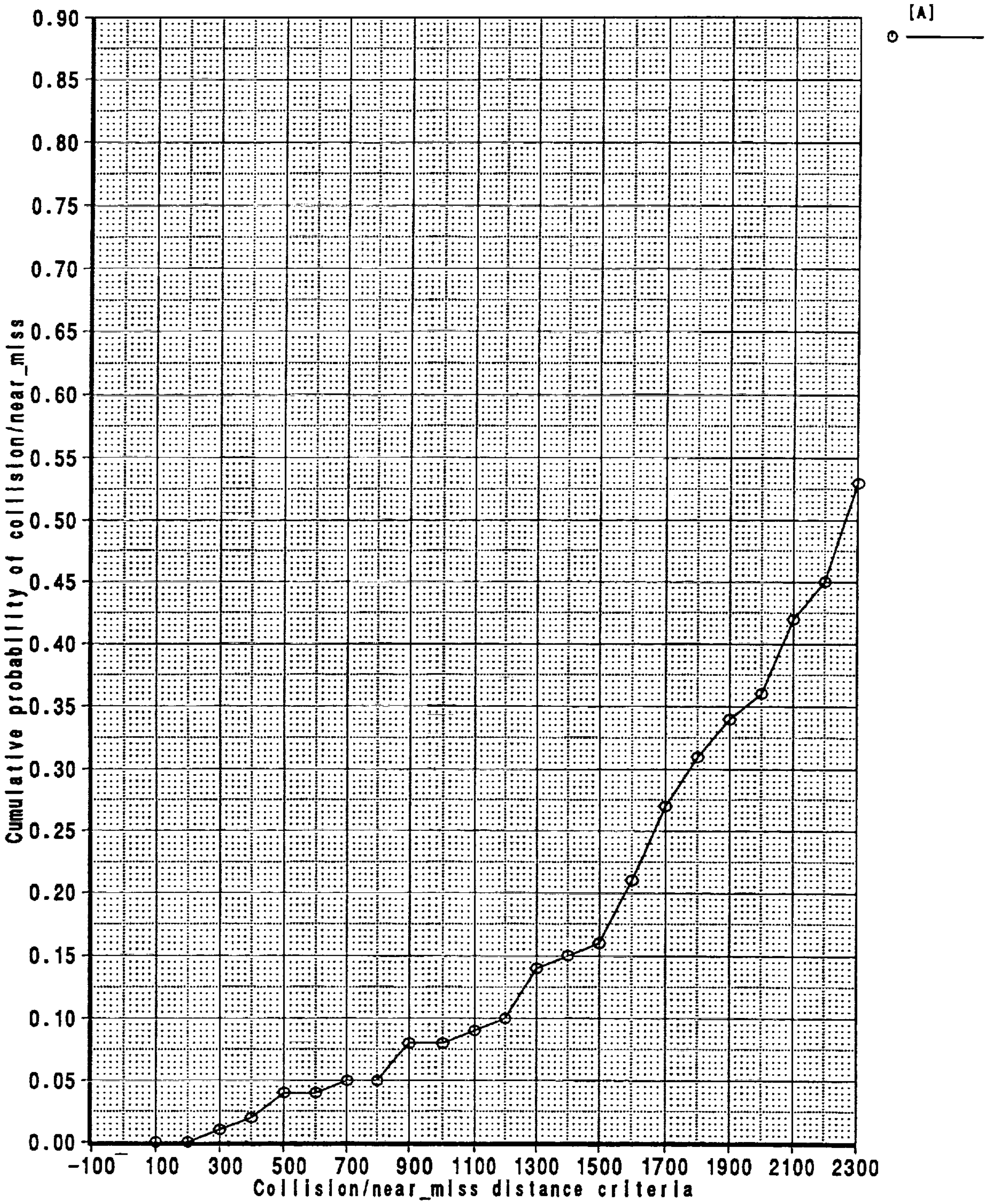

*Figure 5. Plot of **stats.stat***

APPENDIX A

REFERENCE MANUAL

PLAND_BLUNDER USERS GUIDE 5/14/93

INFORMATION TO BUILD PLAND_BLUNDER SIMULATION

The main source files are FORTRAN 77 with extension .f.
They use include files with extensions .inc and .use.
All these files must be in the same working directory.
The build scripts are for the UNIX SYSTEM5 OS.

To compile and link the simulation type: pland.blunder.make
To compile and link the statistics type: pland.stat.make

The simulation uses a random number generator. At Boeing this is available in library /tech/bin/bcslib and the routines are called HSRSUN and HSRSNR. Outside Boeing these routines should be replaced by their equivalents. Changes should be made in FORTRAN file random.f and to the pland.blunder.make script.

INFORMATION TO RUN PLAND_BLUNDER SIMULATION

To run PLAND_BLUNDER simulation, type: pland_exec.exe
The input is in file pland_exec.dat
The output is in file run_rec.track,
optional outputs are files AC_1.track, AC_2.track, RUN_1.track.

To run the statistics counter, type: stats.exe
The input is file run_rec.track,
The output is file stats.stat

In a study, it may be desirable to examine only a subrange of possible initial along-track offset positions. The STEP_T and STEP_DX commands are designed to control the along-track offset positions (via relative start-time or start_distance). The statistics program bases its percentages on only the cases actually run, even though the cases not run probably didnt get close to a collision. The statistics program STATS.F contains a factor STEPFACTOR, which can be set to multiply times the percentages, to account for the cases not run.

OVERVIEW OF COMMANDS FOR THE PLAND_BLUNDER SIMULATION

```
The input to the PLAND_BLUNDER simulation is in a command file 'pland_exec.dat'.
A command interpreter extracts scenario definitions and run parameters from the commands.

Necessary definitions for a PLAND_BLUNDER sim run are:
    Aircraft profiles 1 & 2       : use a AC_CASE cmd for each aircraft.
    Aircraft types                : use a AC_TYPE cmd for each type used.
    Runway geometries 1 & 2       : use a RWY_DEF cmd for each runway,
                                    or a RWY_PAIR cmd to define both.
    Alarm criteria                : use a ALARM cmd to define alarm criteria
    # trials run with same inputs : use a RUN_X cmd after other items are defined.
    QUIT command                  : use a QUIT cmd to signal the end of input.

Optional definitions are :
    Delays for response times     : use a RESPONSE cmd.  Default is 0 delay time.
    Fleetmixes for random aircraft: use a FLEETMIX or ALT_FMIX cmd.
    Offset time/dist limits &     : use a STEP_T cmd.  Default is the AC_CASE Tstart data.
                     stepsize       or a STEP_DX cmd.  Default is the AC_CASE Dstart data.
    Single run tracks turned on   : use a TRACKS cmd.  Default is no tracks files.
```

SAMPLE pland_exec.dat FILE

```
! Comment:  Turn on detailed tracks files
TRACKS

! Comment:  Define aircraft types and fleetmix.
AC_TYPE 1  SIZE  50.0  60.0  30.0 Tresponse  2.0  1.0  SPD 1,2 m+SD  90.0 10.0  70.0  5.0
>>>      ESC ACEL,CLMB m+SD 30.0 10.0 30.0 10.0  TAE ANGLE(mR) m+SD -3.0  10.0
AC_TYPE 2  SIZE 100.0 100.0  50.0 Tresponse  2.0  1.0  SPD 1,2 m+SD 140.0 10.0 100.0  5.0
>>>      ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD -2.0   7.0
AC_TYPE 3  SIZE 150.0 160.0  60.0 Tresponse  3.0  1.0  SPD 1,2 m+SD 160.0 10.0 130.0 10.0
>>>      ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD -2.0   5.0
AC_TYPE 4  SIZE 230.0 200.0  70.0 Tresponse  3.0  1.0  SPD 1,2 m+SD 170.0 10.0 140.0 10.0
>>>      ESC ACEL,CLMB m+SD 30.0 10.0 40.0 10.0  TAE ANGLE(mR) m+SD -2.0   5.0
FLEETMIX (1-6)  10.0  20.0  30.0  40.0   0.0   0.0

! Comment:  Define runway geometry.
RWY_PAIR  SEP 3400.0  NTZ 2000.0

! Comment:  Define alarm criteria and response delay times.
ALARM    Dalarm  300.0
RESPONSE SENSOR GAUSSIAN   3.0    1.0
RESPONSE ATC    DISTR_FILE PRM_proto.ATC.dat
RESPONSE PILOT  GAUSSIAN   4.0    1.0

! Comment:  Define the blunder and escape profiles for the aircraft.
AC_CASE BLUNDER_1  AC 1  TYPE 0  RWY L  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>      dTURN 3.0 Dblund hi,lo 10001.0 9000.0 BLUND m+SD ANG 30.0 1.0 SLOPE 0.0 1.0 DV 0.0 5.0
AC_CASE NORM_ESC_1 AC 2  TYPE 3  RWY R  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>      BANK m+SD 60.0  0.0  HEAD  50.0 CLIMB/ACCEL BY TYPE

! Comment:  Define the range of x-offset geometries and the number of steps.
! Commented out: STEP_T  Tmin,max,step    -3.0    3.0    2.0
STEP_DX  DXmin,max,step -8000.0   8000.0   1000.0

! Comment:  The commands above are order-independent.
! Comment:  The commands below must be last and in that order.
RUN_X        3    SEED    7000000
QUIT
```

off

```
        DEFINITION OF COMMANDS
        ----------------------
TRACKS     -- Turn on single-run time-stamped tracks output.
RWY_DEF    -- Define 1 runway.
RWY_PAIR   -- Define a pair of parallel runways.
RESPONSE   -- Define the delay times describing a systems' response to a blunder.
ALARM      -- Define the condition when a blunder alarm is triggered.
AC_TYPE    -- Define the attributes specific to a class or type of aircraft.
FLEETMIX   -- Define % of each aircraft type for the main fleetmix (TYPE 0 in AC_CASE).
ALT_FMIX   -- Define % of each aircraft type for the alternate fleetmix (TYPE 9 in AC_CASE).
AC_CASE    -- Define 1 aircrafts case profile.
STEP_T     -- Define a series of runs iterating over a range of offset times tween the 2 AC.
STEP_DX    -- Define a series of runs iterating over a range of offset dists tween the 2 AC.
RUN_X      -- Run the monte-carlo simulation, and define the iteration parameters.
QUIT       -- Quit the simulation, no more data.
other      -- Any lines that don't start with one of the above commands are comment lines.


        DEFINITION OF PARAMETERS FOR AC_CASE COMMAND
        --------------------------------------------
AC_CASE          -- Aircraft profile type (NORMAL_1, BLUNDER_1, NORM_ESC_1),
                 -- general description of 1 aircrafts flight,
AC               -- Aircraft ID (1-2)
TYPE             -- Aircraft type or class number (1-6).  Refers to AC_TYPE definition.
                 -- Type 0 uses main random fleetmix, type 9 uses alternate random fleetmix.
RWY              -- Runway aircraft is to land on (L-R).  Refers to RWY_DEF definition.
Dstart           -- Distance from the runway threshold that the simulated aircraft starts at.
Tstart m+SD      -- Time that the simulated aircraft starts moving.

             (FOR normal_1 PROFILE)
no additional parameters

example:
AC_CASE  normal_1   AC 2  RWY L  DISTstart  50000.0

             (FOR blunder_1 PROFILE,    additional parameters on the 2nd line)
dTURN              -- Turn rate of the aircraft during the blunder turn, in deg/sec.
Dblund             -- Distance from the runway threshold that the aircraft blunders at,
   hi,lo              defined by a maximum and minimum distance in feet.
BLUND m+SD
    ANG            -- Blunder angle mean and standard deviation.
    SLOPE          -- Glideslope followed after the blunder, mean & std.dev. in deg, + is up.
    DV             -- Speed change made at the start of the blunder, mean & std.dev. in fps.

example:
AC_CASE BLUNDER_1  AC 1  TYPE 3  RWY L  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>     dTURN 3.0 Dblund hi,lo 60761.0 9000.0 BLUND m+SD ANG 30.0 1.0 SLOPE 0.0 1.0 DV 0.0 5.0

             (FOR norm_esc_1 PROFILE,    additional parameters on the 2nd line)
BANK m+SD          -- Bank angle during the escape maneuver, mean & std.dev, deg.
HEAD               -- Heading to be turned towards during the escape maneuver, deg.

example:
AC_CASE NORM_ESC_1 AC 2  TYPE 4  RWY R  Dstart  70000.0  Tstart m+SD   0.0  0.0
>>>     BANK m+SD 60.0  0.0  HEAD  50.0 CLIMB/ACCEL BY TYPE


        DEFINITION OF PARAMETERS FOR AC_TYPE COMMAND
        --------------------------------------------
AC_TYPE          -- Aircraft type or class number, 1-6.
SIZE             -- Aircraft XYZ dimensions in feet.
Tresponse        -- Aircraft time to respond to controls, mean & std.dev. in secs.
SPD              -- Aircraft speeds, higher spd mean & std.dev, lower spd mean & std.dev, kts.
                 -(The following parameters are on the 2nd line of the AC_TYPE command)
>>> ESC ACEL     -- Aircraft speed increase at start of escape maneuver,  mean & std.dev, fps.
    CLMB m+SD    -- Aircraft climb rate during escape maneuver,           mean & std.dev, fps.
TAE ANGLE(mR)    -- Aircraft total azimuth err (TAE) crosstrack angle toward NTZ
                 -- from rwy centerline at threshold, mean & std.dev, milliradians.
example:
AC_TYPE 4  SIZE 150.0 160.0  60.0 Tresponse  2.0  1.0  SPD 1,2 m+SD 170.0 10.0 140.0 10.0
>>>     ESC ACEL,CLMB m+SD 20.0  5.0 30.0 10.0  TAE ANGLE(mR) m+SD  -1.0   3.0


        DEFINITION OF PARAMETERS FOR FLEETMIX OR ALT_FMIX COMMANDS
        ----------------------------------------------------------
FLEETMIX (1-6) -- Percentages of each aircraft type of the total fleetmix.
                  Aircraft_type 1 is first, type_6 is last, total must=100%.
examples:
FLEETMIX (1-6)  10.0  20.0  30.0  20.0   0.0  20.0
ALT_FMIX (1-6)   0.0   0.0  30.0  20.0  30.0  20.0
```

```
        DEFINITION OF PARAMETERS FOR RWY_DEF COMMAND
        --------------------------------------------
RWY_DEF         -- Runway being defined (L-R)
THRESH          -- Threshold, not yet implemented
CENTERLINE,NOZ  -- Runway centerline y,  normal-operating-zone distance from centerline
                   Assumes runway centerline and NOZ parallel to other runway.
example:
RWY_DEF  R  THRESH  100.0    CENTERLINE,NOZ   -2000.0   1000.0


        DEFINITION OF PARAMETERS FOR RWY_PAIR COMMAND
        ---------------------------------------------
SEP             -- Separation between the 2 parallel runway centerlines, in ft.
NTZ             -- Width of the No-Transgression-Zone in ft.  The NTZ is assumed to be
                -- located symmetrically between the runways.
example:
RWY_PAIR  SEP 3400.0  NTZ 2000.0


        DEFINITION OF PARAMETERS FOR ALARM COMMAND
        ------------------------------------------
Dalarm          -- Distance from the rwy centerline to trigger the alarm, feet.
                -- Also, if the aircraft enters the NTZ then the alarm will trigger.
example:
ALARM    Dalarm  300.0


        DEFINITION OF PARAMETERS FOR RESPONSE COMMAND
        ---------------------------------------------
SENSOR          -- Which system response is being defined. (SENSOR or ATC or COM or PILOT)
GAUSSIAN        -- Type of response time distribution (GAUSSIAN or DISTR_FILE)

             (FOR GAUSSIAN RESPONSE)
               -- GAUSSIAN is followed by the mean and std.dev in secs.
example:
RESPONSE SENSOR GAUSSIAN   3.0    1.0

             (FOR DISTR_FILE RESPONSE)
               -- DISTR_FILE is followed by the name of the file defining the distribution.
example:
RESPONSE ATC    DISTR_FILE PRM_proto.ATC.dat

The DISTR_FILE describes the cumulative distribution of the response times.
The file must have 1 line for each time/probability point, with time 1st and prob. 2nd.
The probability is the proportion of trials when the response occurs at or before the time.
Response time can be negative, indicating prediction.


        DEFINITION OF PARAMETERS FOR STEP_T COMMAND
        -------------------------------------------
Tmin            -- Minimum offset time for AC_2 to follow AC_1 by, secs.
Tmax            -- Maximum offset time for AC_2 to follow AC_1 by, secs.
Tstep           -- Stepsize to vary offset time by, secs.

example:
STEP_T   Tmin,max,step  -100.0  100.0   20.0


        DEFINITION OF PARAMETERS FOR STEP_DX COMMAND
        --------------------------------------------
DXmin           -- Minimum offset distance for AC_2 to follow AC_1 by, feet.
DXmax           -- Maximum offset distance for AC_2 to follow AC_1 by, feet.
DXstep          -- Stepsize to vary offset distance by, feet.

example:
STEP_DX  DXmin,max,step  -6000.0   6000.0   2000.0


        DEFINITION OF PARAMETERS FOR RUN_X COMMAND
        ------------------------------------------
RUN_X           -- Number of monte-carlo runs to make.
SEED            -- Random number generator seed.

example:
RUN_X       1    SEED    2000000
```

COMMAND FORMATS AND EXAMPLES

Each line of each command is presented as 3 lines:
EXAMPLE
BLANK FORM
FORMAT

FLIGHT PROFILE (3 variants, NORM_ESC_1 and BLUNDER_1 variants need 2 lines each)

```
AC_CASE NORMAL_1   AC 1  TYPE 4  RWY L  Dstart  50000.0  Tstart m+SD  10.0  5.0
AC_CASE NORMAL_1   AC _  TYPE _  RWY _  Dstart _________Tstart m+SD ______ _____
22xxxxxxxxxxxxxxxxxxxx17xxxxxx16xxxxxa9xxxxxxxx9ffffffff13xxxxxxxxxxx6fffff6fffff

AC_CASE NORM_ESC_1 AC 2  TYPE 3  RWY R  Dstart  70000.0  Tstart m+SD   0.0  0.0
AC_CASE NORM_ESC_1 AC _  TYPE _  RWY _  Dstart _________Tstart m+SD ______ _____
22xxxxxxxxxxxxxxxxxxxx17xxxxxx16xxxxxa9xxxxxxxx9ffffffff13xxxxxxxxxxx6fffff6fffff
>>>     BANK m+SD 60.0  0.0  HEAD  50.0 CLIMB/ACCEL BY TYPE
>>>     BANK m+SD ____ ____  HEAD _____ CLIMB/ACCEL BY TYPE
18xxxxxxxxxxxxxxxx5ffff5ffff6xxxxx5ffff

AC_CASE BLUNDER_1  AC 1  TYPE 3  RWY L  Dstart  70000.0  Tstart m+SD   0.0  0.0
AC_CASE BLUNDER_1  AC _  TYPE _  RWY _  Dstart _________Tstart m+SD ______ _____
22xxxxxxxxxxxxxxxxxxxx17xxxxxx16xxxxxa9xxxxxxxx9ffffffff13xxxxxxxxxxx6fffff6fffff
>>>     dTURN  3.0 Dblund hi,lo 60761.0 60761.0  BLUND m+SD ANG  30.0  1.0 SLOPE  0.0  1.0 DV  0.0 10.0
>>>     dTURN ____ Dblund hi,lo _______ _______  BLUND m+SD ANG _____ ____ SLOPE ____ ____ DV ____ ____
14xxxxxxxxxxxx4fff14xxxxxxxxxxxx8fffffff8fffffff16xxxxxxxxxxxxxx6fffff5ffff6xxxxx5ffff5ffff3xx5ffff5ffff
```

AC_TYPE DEFINITION (2 lines per command)

```
AC_TYPE 4  SIZE 150.0 160.0  60.0 Tresponse  2.0  1.0  SPD 1,2 m+SD 160.0 10.0 130.0  5.0
AC_TYPE _  SIZE _____ _____ _____ Tresponse ____ ____  SPD 1,2 m+SD _____ ____ _____ ____
8aaaaaaa17xxxxxx6fffff6fffff6fffff10xxxxxxxx5ffff5ffff14xxxxxxxxxxxx6fffff5 fff6fffff5ffff
>>>     ESC ACEL,CLMB m+SD 20.0  5.0 30.0 10.0  TAE ANGLE(mR) m+SD  -1.0   3.0
>>>     ESC ACEL,CLMB m+SD ____ ____ ____ ____  TAE ANGLE(mR) m+SD _____ _____
27xxxxxxxxxxxxxxxxxxxxxxxxx5ffff5ffff5ffff5ffff20xxxxxxxxxxxxxxxxxx6fffff6fffff
```

FLEETMIX DEFINITION (2 variants)

```
FLEETMIX (1-6)  10.0  20.0  30.0  20.0   0.0  20.0
FLEETMIX (1-6) _____ _____ _____ _____ _____ _____
8aaaaaaa8xxxxxxx6fffff6fffff6fffff6fffff6fffff6fffff

ALT_FMIX (1-6)   0.0   0.0  30.0  20.0  30.0  20.0
ALT_FMIX (1-6) _____ _____ _____ _____ _____ _____
8aaaaaaa8xxxxxxx6fffff6fffff6fffff6fffff6fffff6fffff
```

RUNWAY DEFINITION COMMAND (2 variants)

```
RWY_DEF  R  THRESH  100.0    CENTERLINE,NOZ   -2000.0   1000.0
RWY_DEF  _  THRESH _________ CENTERLINE,NOZ  ________ ________
8aaaaaaaxa9xxxxxxxx9ffffffff17xxxxxxxxxxxxxxx8fffffffx8fffffff

RWY_PAIR  SEP 3400.0  NTZ 2000.0
RWY_PAIR  SEP ______  NTZ ______
8aaaaaaa6xxxxx7ffffff5xxxx7ffffff
```

ALARM DEFINITION COMMAND

```
ALARM    Dalarm  650.0
ALARM    Dalarm _______
16xxxxxxxxxxxxxx7ffffff
```

RESPONSE DELAY TIME DEFINITION COMMAND (2 variants)

```
RESPONSE SENSOR GAUSSIAN   30.0 10.0
RESPONSE ______ GAUSSIAN  ____ ____
9xxxxxxxx6aaaaax10aaaaaaaax5ffff5ffff

RESPONSE ATC    DISTR_FILE PRM_proto.ATC.dat
RESPONSE ______ DISTR_FILE ____________________________
9xxxxxxxx6aaaaax10aaaaaaaax28aaaaaaaaaaaaaaaaaaaaaaaaaa
```

TIME OFFSET ITERATION COMMAND

```
STEP_T   Tmin,max,step  -100.0  100.0   20.0
STEP_T   Tmin,max,step
8aaaaaaa16xxxxxxxxxxxxxx7ffffff7ffffff7ffffff
```

DISTANCE OFFSET ITERATION COMMAND

```
STEP_DX  DXmin,max,step -10000.0  10000.0   1000.0
STEP_DX  DXmin,max,step
8aaaaaaa16xxxxxxxxxxxxxx9ffffffff9ffffffff9ffffffff
```

MONTE-CARLO RUN COMMAND

```
RUN_X        9     SEED     2000000
RUN_X              SEED
8aaaaaaax5iiii9xxxxxxxx10iiiiiiii
```

APPENDIX B

OUTPUT FILES

TABLE B1.-run_rec.track Output File

PROFILE#1	RWY	TYPE	Dstrt#1	Tstrt#1	v1#1	v2#1	data1#1	data2#1	data3#1	PROFILE#2	RWY	TYPE	Dstrt#2	Tstrt#2	v1#2	v2#2	data1#2	data2#2	data3#2	ERRCODE	AVOID	Tresp	Dmiss.shad	Dmiss
BLUNDER_1	L	4	65000.0	0.0	304.0	234.2	304.0	30.0	-3.0	NORM_ESC_1	R	3	62500.0	0.0	251.6	183.7	22.0	25.0	251.6	0	T	6.3	1304.8	1502.5
BLUNDER_1	L	6	65000.0	0.0	299.9	236.9	299.9	30.0	-3.0	NORM_ESC_1	R	5	62500.0	0.0	308.8	234.5	22.0	42.0	308.8	0	T	-1.7	3554.3	3808.1
BLUNDER_1	L	6	65000.0	0.0	300.0	235.8	300.0	30.0	-3.0	NORM_ESC_1	R	1	62500.0	0.0	255.0	165.4	22.0	33.0	255.0	0	T	7.5	1685.6	1733.0
BLUNDER_1	L	6	65000.0	0.0	300.8	240.9	300.8	30.0	-3.0	NORM_ESC_1	R	2	62500.0	0.0	249.6	184.6	22.0	17.0	249.6	0	T	8.7	1443.8	1283.6
BLUNDER_1	L	5	65000.0	0.0	310.1	236.5	310.1	30.0	-3.0	NORM_ESC_1	R	6	62750.0	0.0	299.3	234.6	22.0	50.0	299.3	0	T	8.2	2615.5	2204.3
BLUNDER_1	L	5	65000.0	0.0	308.5	233.1	308.5	30.0	-3.0	NORM_ESC_1	R	3	62750.0	0.0	246.3	186.5	22.0	25.0	246.3	0	T	0.2	806.5	2273.3
BLUNDER_1	L	1	65000.0	0.0	248.4	164.8	248.4	30.0	-3.0	NORM_ESC_1	R	5	62750.0	0.0	303.9	235.0	22.0	42.0	303.9	0	T	10.8	4120.8	4120.8
BLUNDER_1	L	6	65000.0	0.0	310.1	232.3	310.1	30.0	-3.0	NORM_ESC_1	R	6	62750.0	0.0	302.0	235.4	22.0	50.0	302.0	0	T	16.9	2764.6	1870.7
BLUNDER_1	L	5	65000.0	0.0	301.5	237.7	301.5	30.0	-3.0	NORM_ESC_1	R	3	63000.0	0.0	256.3	183.5	22.0	25.0	256.3	0	T	-3.9	1087.4	2426.8
BLUNDER_1	L	5	65000.0	0.0	303.1	230.2	303.1	30.0	-3.0	NORM_ESC_1	R	3	63000.0	0.0	251.6	185.6	22.0	25.0	251.6	0	T	-2.3	945.1	2513.3
BLUNDER_1	L	6	65000.0	0.0	302.2	235.6	302.2	30.0	-3.0	NORM_ESC_1	R	5	63000.0	0.0	307.2	241.0	22.0	42.0	307.2	0	T	6.2	2879.9	2987.7
BLUNDER_1	L	5	65000.0	0.0	296.9	239.3	296.9	30.0	-3.0	NORM_ESC_1	R	4	63000.0	0.0	307.2	234.7	22.0	33.0	307.2	0	T	2.3	3098.6	3372.4
BLUNDER_1	L	4	65000.0	0.0	305.2	232.2	305.2	30.0	-3.0	NORM_ESC_1	R	5	63250.0	0.0	307.0	234.6	22.0	42.0	307.0	0	T	-3.1	2599.3	3044.6
BLUNDER_1	L	1	65000.0	0.0	248.6	166.3	248.6	30.0	-3.0	NORM_ESC_1	R	6	63250.0	0.0	300.0	237.6	22.0	50.0	300.0	0	T	10.9	3669.6	3669.6
BLUNDER_1	L	4	65000.0	0.0	304.1	237.1	304.1	30.0	-3.0	NORM_ESC_1	R	4	63250.0	0.0	304.4	234.3	22.0	33.0	304.4	0	T	-1.0	2472.8	3083.8
BLUNDER_1	L	2	65000.0	0.0	253.7	185.1	253.7	30.0	-3.0	NORM_ESC_1	R	6	63250.0	0.0	310.0	235.3	22.0	50.0	310.0	0	T	-0.4	4600.9	4600.9
BLUNDER_1	L	6	65000.0	0.0	303.9	233.4	303.9	30.0	-3.0	NORM_ESC_1	R	5	63500.0	0.0	301.3	233.1	22.0	42.0	301.3	0	T	4.5	2171.5	2294.4
BLUNDER_1	L	6	65000.0	0.0	297.9	236.1	297.9	30.0	-3.0	NORM_ESC_1	R	5	63500.0	0.0	306.2	239.0	22.0	42.0	306.2	0	T	17.0	2671.3	2377.7
BLUNDER_1	L	6	65000.0	0.0	298.4	237.4	298.4	30.0	-3.0	NORM_ESC_1	R	4	63500.0	0.0	306.3	236.3	22.0	33.0	306.3	0	T	2.4	2631.1	2902.8
BLUNDER_1	L	5	65000.0	0.0	302.3	240.6	302.3	30.0	-3.0	NORM_ESC_1	R	1	63500.0	0.0	250.4	169.6	22.0	33.0	250.4	0	T	12.8	452.8	108.5
BLUNDER_1	L	5	65000.0	0.0	305.9	239.8	305.9	30.0	-3.0	NORM_ESC_1	R	5	63750.0	0.0	297.2	237.4	22.0	42.0	297.2	0	T	11.9	1730.8	1491.7
BLUNDER_1	L	5	65000.0	0.0	305.8	235.5	305.8	30.0	-3.0	NORM_ESC_1	R	6	63750.0	0.0	302.1	235.2	22.0	50.0	302.1	0	T	9.2	1957.3	2078.0
BLUNDER_1	L	5	65000.0	0.0	306.1	236.6	306.1	30.0	-3.0	NORM_ESC_1	R	5	63750.0	0.0	303.2	240.7	22.0	42.0	303.2	0	T	6.4	1942.9	2077.6
BLUNDER_1	L	1	65000.0	0.0	251.5	158.4	251.5	30.0	-3.0	NORM_ESC_1	R	5	63750.0	0.0	303.7	233.2	22.0	42.0	303.7	0	T	10.5	3880.3	3880.3
BLUNDER_1	L	4	65000.0	0.0	300.5	234.7	300.5	30.0	-3.0	NORM_ESC_1	R	5	64000.0	0.0	309.2	237.8	22.0	42.0	309.2	0	T	1.9	1965.6	2472.3
BLUNDER_1	L	6	65000.0	0.0	306.3	234.0	306.3	30.0	-3.0	NORM_ESC_1	R	3	64000.0	0.0	251.0	181.8	22.0	25.0	251.0	0	T	13.3	140.4	247.4
BLUNDER_1	L	5	65000.0	0.0	305.6	237.6	305.6	30.0	-3.0	NORM_ESC_1	R	5	64000.0	0.0	305.4	237.6	22.0	42.0	305.4	0	T	2.6	1973.3	2409.2
BLUNDER_1	L	5	65000.0	0.0	301.7	240.6	301.7	30.0	-3.0	NORM_ESC_1	R	2	64000.0	0.0	259.7	188.2	22.0	17.0	259.7	0	T	11.6	250.1	489.4
BLUNDER_1	L	4	65000.0	0.0	305.1	237.9	305.1	30.0	-3.0	NORM_ESC_1	R	2	64250.0	0.0	254.2	186.9	22.0	17.0	254.2	0	T	13.6	266.2	380.6
BLUNDER_1	L	1	65000.0	0.0	257.5	163.6	257.5	30.0	-3.0	NORM_ESC_1	R	5	64250.0	0.0	299.7	237.1	22.0	42.0	299.7	0	T	0.7	3024.9	3206.6
BLUNDER_1	L	4	65000.0	0.0	303.4	231.0	303.4	30.0	-3.0	NORM_ESC_1	R	3	64250.0	0.0	250.8	187.0	22.0	25.0	250.8	0	T	0.0	386.9	2319.4
BLUNDER_1	L	5	65000.0	0.0	304.7	231.4	304.7	30.0	-3.0	NORM_ESC_1	R	1	64250.0	0.0	256.6	166.2	22.0	33.0	256.6	0	T	-1.6	281.1	2191.7
BLUNDER_1	L	1	65000.0	0.0	255.0	165.3	255.0	30.0	-3.0	NORM_ESC_1	R	5	64500.0	0.0	304.7	241.7	22.0	42.0	304.7	0	T	3.9	3175.5	3304.4
BLUNDER_1	L	4	65000.0	0.0	304.0	235.8	304.0	30.0	-3.0	NORM_ESC_1	R	5	64500.0	0.0	306.3	235.6	22.0	42.0	306.3	0	T	7.1	1434.8	1928.8
BLUNDER_1	L	6	65000.0	0.0	300.0	244.7	300.0	30.0	-3.0	NORM_ESC_1	R	5	64500.0	0.0	304.1	232.6	22.0	42.0	304.1	0	T	8.1	1395.7	1627.3
BLUNDER_1	L	3	65000.0	0.0	250.6	183.8	250.6	30.0	-3.0	NORM_ESC_1	R	4	64500.0	0.0	307.6	233.8	22.0	33.0	307.6	0	T	5.0	3324.3	3365.0
BLUNDER_1	L	6	65000.0	0.0	301.3	233.4	301.3	30.0	-3.0	NORM_ESC_1	R	5	64750.0	0.0	303.7	239.2	22.0	42.0	303.7	0	T	2.1	1288.1	2032.1
BLUNDER_1	L	3	65000.0	0.0	251.9	186.7	251.9	30.0	-3.0	NORM_ESC_1	R	5	64750.0	0.0	300.4	233.9	22.0	42.0	300.4	0	T	0.1	2913.5	3208.8
BLUNDER_1	L	4	65000.0	0.0	312.7	236.1	312.7	30.0	-3.0	NORM_ESC_1	R	2	64750.0	0.0	254.7	188.0	22.0	17.0	254.7	0	T	-6.4	1039.7	2257.0
BLUNDER_1	L	5	65000.0	0.0	302.6	237.1	302.6	30.0	-3.0	NORM_ESC_1	R	5	64750.0	0.0	305.7	235.0	22.0	42.0	305.7	0	T	7.5	1160.8	1600.7
BLUNDER_1	L	5	65000.0	0.0	301.1	234.3	301.1	30.0	-3.0	NORM_ESC_1	R	5	65000.0	0.0	302.4	236.6	22.0	42.0	302.4	0	T	4.7	835.2	1370.7
BLUNDER_1	L	6	65000.0	0.0	301.2	240.0	301.2	30.0	-3.0	NORM_ESC_1	R	5	65000.0	0.0	306.9	233.7	22.0	42.0	306.9	0	T	9.1	891.3	1051.9
BLUNDER_1	L	4	65000.0	0.0	308.4	236.0	308.4	30.0	-3.0	NORM_ESC_1	R	5	65000.0	0.0	302.7	235.5	22.0	42.0	302.7	0	T	9.8	617.8	860.0
BLUNDER_1	L	1	65000.0	0.0	255.3	169.9	255.3	30.0	-3.0	NORM_ESC_1	R	4	65000.0	0.0	305.1	237.3	22.0	33.0	305.1	0	T	8.8	2538.2	2586.6
BLUNDER_1	L	2	65000.0	0.0	251.1	186.5	251.1	30.0	-3.0	NORM_ESC_1	R	1	65250.0	0.0	255.6	163.3	22.0	33.0	255.6	0	T	8.9	846.9	1553.8
BLUNDER_1	L	4	65000.0	0.0	302.7	230.0	302.7	30.0	-3.0	NORM_ESC_1	R	5	65250.0	0.0	301.9	235.4	22.0	42.0	301.9	0	T	9.4	564.7	887.4
BLUNDER_1	L	5	65000.0	0.0	302.7	235.8	302.7	30.0	-3.0	NORM_ESC_1	R	5	65250.0	0.0	302.0	235.1	22.0	42.0	302.0	0	T	9.0	515.6	1157.3
BLUNDER_1	L	4	65000.0	0.0	302.3	239.7	302.3	30.0	-3.0	NORM_ESC_1	R	5	65250.0	0.0	303.2	234.3	22.0	42.0	303.2	0	T	-3.3	583.8	2243.5
BLUNDER_1	L	4	65000.0	0.0	302.0	233.5	302.0	30.0	-3.0	NORM_ESC_1	R	4	65500.0	0.0	305.0	235.1	22.0	33.0	305.0	0	T	-2.1	514.8	2044.2
BLUNDER_1	L	6	65000.0	0.0	302.2	234.3	302.2	30.0	-3.0	NORM_ESC_1	R	4	65500.0	0.0	303.5	235.9	22.0	33.0	303.5	0	T	6.0	400.3	1233.3
BLUNDER_1	L	6	65000.0	0.0	302.1	236.2	302.1	30.0	-3.0	NORM_ESC_1	R	2	65500.0	0.0	251.9	191.1	22.0	17.0	251.9	0	T	-3.1	1604.0	2840.7
BLUNDER_1	L	6	65000.0	0.0	304.3	240.8	304.3	30.0	-3.0	NORM_ESC_1	R	5	65500.0	0.0	300.9	239.2	22.0	42.0	300.9	0	T	-5.4	204.0	2319.0
BLUNDER_1	L	5	65000.0	0.0	310.8	240.5	310.8	30.0	-3.0	NORM_ESC_1	R	5	65750.0	0.0	306.6	235.6	22.0	42.0	306.6	0	T	2.2	93.6	1919.3
BLUNDER_1	L	5	65000.0	0.0	305.7	238.3	305.7	30.0	-3.0	NORM_ESC_1	R	5	65750.0	0.0	304.1	236.3	22.0	42.0	304.1	0	T	0.8	125.0	2266.8
BLUNDER_1	L	5	65000.0	0.0	308.7	235.7	308.7	30.0	-3.0	NORM_ESC_1	R	1	65750.0	0.0	253.7	169.3	22.0	33.0	253.7	0	T	2.1	1942.0	2648.4
BLUNDER_1	L	5	65000.0	0.0	306.3	236.3	306.3	30.0	-3.0	NORM_ESC_1	R	5	65750.0	0.0	306.0	236.5	22.0	42.0	306.0	0	T	2.5	147.4	1718.5
BLUNDER_1	L	6	65000.0	0.0	301.5	233.9	301.5	30.0	-3.0	NORM_ESC_1	R	5	66000.0	0.0	295.9	237.5	22.0	42.0	295.9	0	T	4.1	371.7	1630.3
BLUNDER_1	L	5	65000.0	0.0	295.7	239.1	295.7	30.0	-3.0	NORM_ESC_1	R	5	66000.0	0.0	301.6	237.6	22.0	42.0	301.6	0	T	1.7	48.8	1795.0
BLUNDER_1	L	5	65000.0	0.0	306.9	232.4	306.9	30.0	-3.0	NORM_ESC_1	R	4	66000.0	0.0	306.4	237.9	22.0	33.0	306.4	0	T	3.0	186.4	1824.1
BLUNDER_1	L	6	65000.0	0.0	303.8	235.6	303.8	30.0	-3.0	NORM_ESC_1	R	5	66000.0	0.0	302.4	242.0	22.0	42.0	302.4	0	T	-7.6	254.5	2510.6
BLUNDER_1	L	1	65000.0	0.0	255.6	165.9	255.6	30.0	-3.0	NORM_ESC_1	R	5	66250.0	0.0	307.1	239.9	22.0	42.0	307.1	0	T	-6.5	1658.8	2694.1
BLUNDER_1	L	2	65000.0	0.0	250.1	180.4	250.1	30.0	-3.0	NORM_ESC_1	R	2	66250.0	0.0	249.3	181.1	22.0	17.0	249.3	0	T	0.6	361.1	2758.2
BLUNDER_1	L	2	65000.0	0.0	256.7	188.4	256.7	30.0	-3.0	NORM_ESC_1	R	5	66250.0	0.0	302.5	239.8	22.0	42.0	302.5	0	T	5.4	1467.8	1889.3
BLUNDER_1	L	6	65000.0	0.0	304.9	237.0	304.9	30.0	-3.0	NORM_ESC_1	R	4	66250.0	0.0	309.3	237.1	22.0	33.0	309.3	0	T	7.7	180.7	1287.1
BLUNDER_1	L	5	65000.0	0.0	303.2	242.2	303.2	30.0	-3.0	NORM_ESC_1	R	6	66500.0	0.0	310.4	238.7	22.0	50.0	310.4	0	T	2.9	337.6	1598.6
BLUNDER_1	L	4	65000.0	0.0	299.6	244.4	299.6	30.0	-3.0	NORM_ESC_1	R	4	66500.0	0.0	306.8	231.7	22.0	33.0	306.8	0	T	11.9	307.6	684.6
BLUNDER_1	L	5	65000.0	0.0	306.2	237.7	306.2	30.0	-3.0	NORM_ESC_1	R	5	66500.0	0.0	305.2	231.8	22.0	42.0	305.2	0	T	6.0	743.3	1664.3
BLUNDER_1	L	5	65000.0	0.0	308.2	235.5	308.2	30.0	-3.0	NORM_ESC_1	R	5	66500.0	0.0	298.0	239.5	22.0	42.0	298.0	0	T	0.6	985.3	2421.4
BLUNDER_1	L	5	65000.0	0.0	305.6	240.8	305.6	30.0	-3.0	NORM_ESC_1	R	4	66750.0	0.0	301.8	239.7	22.0	33.0	301.8	0	T	8.6	879.7	1561.8
BLUNDER_1	L	5	65000.0	0.0	301.3	237.3	301.3	30.0	-3.0	NORM_ESC_1	R	5	66750.0	0.0	309.1	236.5	22.0	42.0	309.1	0	T	2.2	619.5	2071.4
BLUNDER_1	L	5	65000.0	0.0	304.8	231.3	304.8	30.0	-3.0	NORM_ESC_1	R	5	66750.0	0.0	308.6	237.0	22.0	42.0	308.6	0	T	1.8	731.0	2107.5
BLUNDER_1	L	5	65000.0	0.0	304.1	236.1	304.1	30.0	-3.0	NORM_ESC_1	R	6	66750.0	0.0	301.2	240.7	22.0	50.0	301.2	0	T	5.7	946.0	1655.1
BLUNDER_1	L	5	65000.0	0.0	302.9	240.4	302.9	30.0	-3.0	NORM_ESC_1	R	5	67000.0	0.0	297.3	235.3	22.0	42.0	297.3	0	T	8.1	1296.3	1862.2
BLUNDER_1	L	5	65000.0	0.0	300.7	238.4	300.7	30.0	-3.0	NORM_ESC_1	R	3	67000.0	0.0	252.2	187.5	22.0	25.0	252.2	0	T	6.0	2993.3	3368.4

BLUNDER_1	L	5	65000.0	0.0	306.9	237.1	306.9	30.0	-3.0	NORM_ESC_1	R	6	67000.0	0.0	310.5	237.9	22.0	50.0	310.5	0	T	2.9	821.3	2260.9
BLUNDER_1	L	1	65000.0	0.0	254.9	173.8	254.9	30.0	-3.0	NORM_ESC_1	R	5	67000.0	0.0	308.3	237.0	22.0	42.0	308.3	0	T	4.3	735.6	1680.3
BLUNDER_1	L	1	65000.0	0.0	257.1	168.4	257.1	30.0	-3.0	NORM_ESC_1	R	5	67250.0	0.0	305.3	237.3	22.0	42.0	305.3	0	T	1.7	685.0	2227.6
BLUNDER_1	L	2	65000.0	0.0	246.8	183.7	246.8	30.0	-3.0	NORM_ESC_1	R	5	67250.0	0.0	303.4	237.0	22.0	42.0	303.4	0	T	-3.1	994.7	2405.8
BLUNDER_1	L	5	65000.0	0.0	307.2	236.9	307.2	30.0	-3.0	NORM_ESC_1	R	4	67250.0	0.0	306.9	237.0	22.0	33.0	306.9	0	T	6.5	1390.1	2001.9
BLUNDER_1	L	5	65000.0	0.0	305.2	238.2	305.2	30.0	-3.0	NORM_ESC_1	R	3	67250.0	0.0	256.8	193.2	22.0	25.0	256.8	0	T	6.8	3250.3	3510.0
BLUNDER_1	L	3	65000.0	0.0	254.6	179.8	254.6	30.0	-3.0	NORM_ESC_1	R	5	67500.0	0.0	301.8	234.4	22.0	42.0	301.8	0	T	-2.1	480.8	2707.9
BLUNDER_1	L	5	65000.0	0.0	306.8	240.7	306.8	30.0	-3.0	NORM_ESC_1	R	6	67500.0	0.0	305.8	235.8	22.0	50.0	305.8	0	T	2.5	1570.3	2724.9
BLUNDER_1	L	5	65000.0	0.0	306.5	236.1	306.5	30.0	-3.0	NORM_ESC_1	R	5	67500.0	0.0	304.1	235.5	22.0	42.0	304.1	0	T	5.6	1562.3	2265.2
BLUNDER_1	L	2	65000.0	0.0	249.4	187.5	249.4	30.0	-3.0	NORM_ESC_1	R	4	67500.0	0.0	301.3	236.7	22.0	33.0	301.3	0	T	-0.1	715.1	2538.2
BLUNDER_1	L	4	65000.0	0.0	302.2	236.0	302.2	30.0	-3.0	NORM_ESC_1	R	6	67750.0	0.0	301.1	239.7	22.0	50.0	301.1	0	T	4.3	1846.6	2715.7
BLUNDER_1	L	1	65000.0	0.0	254.5	165.1	254.5	30.0	-3.0	NORM_ESC_1	R	5	67750.0	0.0	301.0	238.7	22.0	42.0	301.0	0	T	9.6	309.4	1233.5
BLUNDER_1	L	2	65000.0	0.0	249.4	181.3	249.4	30.0	-3.0	NORM_ESC_1	R	5	67750.0	0.0	305.4	235.2	22.0	42.0	305.4	0	T	5.3	799.1	2111.6
BLUNDER_1	L	3	65000.0	0.0	251.4	184.1	251.4	30.0	-3.0	NORM_ESC_1	R	5	67750.0	0.0	302.9	231.0	22.0	42.0	302.9	0	T	8.7	544.1	1299.6
BLUNDER_1	L	4	65000.0	0.0	305.2	235.7	305.2	30.0	-3.0	NORM_ESC_1	R	1	68000.0	0.0	249.9	166.4	22.0	33.0	249.9	0	T	7.7	4227.0	4327.7
BLUNDER_1	L	2	65000.0	0.0	259.7	182.6	259.7	30.0	-3.0	NORM_ESC_1	R	5	68000.0	0.0	308.0	238.3	22.0	42.0	308.0	0	T	-8.7	64.2	2461.8
BLUNDER_1	L	5	65000.0	0.0	308.8	236.4	308.8	30.0	-3.0	NORM_ESC_1	R	5	68000.0	0.0	303.4	235.2	22.0	42.0	303.4	0	T	3.6	2184.1	3131.0
BLUNDER_1	L	3	65000.0	0.0	249.6	183.1	249.6	30.0	-3.0	NORM_ESC_1	R	5	68000.0	0.0	309.6	240.6	22.0	42.0	309.6	0	T	8.2	601.7	1571.1
BLUNDER_1	L	5	65000.0	0.0	303.3	234.6	303.3	30.0	-3.0	NORM_ESC_1	R	6	68250.0	0.0	309.6	235.6	22.0	50.0	309.6	0	T	3.8	2172.6	3298.7
BLUNDER_1	L	5	65000.0	0.0	303.7	243.6	303.7	30.0	-3.0	NORM_ESC_1	R	5	68250.0	0.0	298.6	238.9	22.0	42.0	298.6	0	T	3.4	2453.1	3504.0
BLUNDER_1	L	6	65000.0	0.0	308.4	236.6	308.4	30.0	-3.0	NORM_ESC_1	R	5	68250.0	0.0	306.5	236.5	22.0	42.0	306.5	0	T	8.1	2422.4	2922.1
BLUNDER_1	L	1	65000.0	0.0	251.7	168.2	251.7	30.0	-3.0	NORM_ESC_1	R	5	68250.0	0.0	302.5	232.4	22.0	42.0	302.5	0	T	12.0	134.6	876.9
BLUNDER_1	L	4	65000.0	0.0	299.1	239.5	299.1	30.0	-3.0	NORM_ESC_1	R	2	68500.0	0.0	258.8	185.3	22.0	17.0	258.8	0	T	6.7	4196.5	4500.0
BLUNDER_1	L	5	65000.0	0.0	302.8	238.3	302.8	30.0	-3.0	NORM_ESC_1	R	2	68500.0	0.0	259.4	185.7	22.0	17.0	259.4	0	T	4.2	4332.6	4551.5
BLUNDER_1	L	5	65000.0	0.0	303.1	237.6	303.1	30.0	-3.0	NORM_ESC_1	R	4	68500.0	0.0	306.2	239.0	22.0	33.0	306.2	0	T	7.3	2405.3	3000.3
BLUNDER_1	L	5	65000.0	0.0	303.7	233.6	303.7	30.0	-3.0	NORM_ESC_1	R	5	68500.0	0.0	299.7	230.9	22.0	42.0	299.7	0	T	6.5	2694.4	3094.7

TABLE B2.-AC_1.track Output File

*ESA
run1
*FLOAT

T1	RWY_1isL	X1	Y1	Z1	LEG1	HEAD1	V1	BANK1	SLOPE1
0.5	1	-64848.0	-1963.7	3398.5	1	0.2	304.0	0.0	-3.0
1.0	1	-64696.0	-1963.1	3390.5	1	0.2	304.0	0.0	-3.0
1.5	1	-64544.0	-1962.5	3382.6	1	0.2	304.0	0.0	-3.0
2.0	1	-64392.0	-1961.8	3374.6	1	0.2	304.0	0.0	-3.0
2.5	1	-64240.0	-1961.2	3366.7	1	0.2	304.0	0.0	-3.0
3.0	1	-64088.0	-1960.6	3358.7	1	0.2	304.0	0.0	-3.0
3.5	1	-63936.0	-1960.0	3350.8	1	0.2	304.0	0.0	-3.0
4.0	1	-63784.0	-1959.4	3342.8	1	0.2	304.0	0.0	-3.0
4.5	1	-63632.0	-1958.7	3334.9	1	0.2	304.0	0.0	-3.0
5.0	1	-63480.0	-1958.1	3326.9	1	0.2	304.0	0.0	-3.0
5.5	1	-63328.0	-1957.5	3318.9	1	0.2	304.0	0.0	-3.0
6.0	1	-63176.0	-1956.9	3311.0	1	0.2	304.0	0.0	-3.0
6.5	1	-63023.9	-1956.3	3303.0	1	0.2	304.0	0.0	-3.0
7.0	1	-62871.9	-1955.7	3295.1	1	0.2	304.0	0.0	-3.0
7.5	1	-62719.9	-1955.0	3287.1	1	0.2	304.0	0.0	-3.0
8.0	1	-62567.9	-1954.4	3279.2	1	0.2	304.0	0.0	-3.0
8.5	1	-62415.9	-1953.8	3271.2	1	0.2	304.0	0.0	-3.0
9.0	1	-62263.9	-1953.2	3263.3	1	0.2	304.0	0.0	-3.0
9.5	1	-62111.9	-1952.6	3255.3	1	0.2	304.0	0.0	-3.0
10.0	1	-61959.9	-1951.9	3247.3	1	0.2	304.0	0.0	-3.0
10.5	1	-61807.9	-1951.3	3239.4	1	0.2	304.0	0.0	-3.0
11.0	1	-61655.9	-1950.7	3231.4	1	0.2	304.0	0.0	-3.0
11.5	1	-61503.9	-1948.4	3223.5	1	1.6	304.0	26.4	-3.0
12.0	1	-61352.1	-1942.1	3215.5	1	3.1	304.0	26.4	-3.0
12.5	1	-61200.4	-1931.8	3207.6	1	4.6	304.0	26.4	-3.0
13.0	1	-61049.1	-1917.6	3199.6	1	6.1	304.0	26.4	-3.0
13.5	1	-60898.2	-1899.4	3191.7	1	7.6	304.0	26.4	-3.0
14.0	1	-60747.8	-1877.3	3183.7	1	9.1	304.0	26.4	-3.0
14.5	1	-60598.1	-1851.2	3175.8	1	10.6	304.0	26.4	-3.0
15.0	1	-60449.1	-1821.2	3167.8	1	12.1	304.0	26.4	-3.0
15.5	1	-60300.9	-1787.4	3159.8	1	13.6	304.0	26.4	-3.0
16.0	1	-60153.7	-1749.7	3151.9	1	15.1	304.0	26.4	-3.0
16.5	1	-60007.5	-1708.1	3143.9	1	16.6	304.0	26.4	-3.0
17.0	1	-59862.4	-1662.7	3136.0	1	18.1	304.0	26.4	-3.0
17.5	1	-59718.6	-1613.5	3128.0	1	19.6	304.0	26.4	-3.0
18.0	1	-59576.1	-1560.6	3120.1	1	21.1	304.0	26.4	-3.0
18.5	1	-59435.1	-1504.0	3112.1	1	22.6	304.0	26.4	-3.0
19.0	1	-59295.6	-1443.7	3104.2	1	24.1	304.0	26.4	-3.0
19.5	1	-59157.7	-1379.8	3096.2	1	25.6	304.0	26.4	-3.0
20.0	1	-59021.5	-1312.3	3088.2	1	27.1	304.0	26.4	-3.0
20.5	1	-58887.1	-1241.2	3080.3	1	28.6	304.0	26.4	-3.0
21.0	1	-58754.7	-1166.7	3072.3	2	30.0	304.0	0.0	-3.0
21.5	1	-58623.0	-1090.7	3064.4	2	30.0	304.0	0.0	-3.0
22.0	1	-58491.4	-1014.7	3056.4	2	30.0	304.0	0.0	-3.0
22.5	1	-58359.8	-938.7	3048.5	2	30.0	304.0	0.0	-3.0
23.0	1	-58228.1	-862.7	3040.5	2	30.0	304.0	0.0	-3.0
23.5	1	-58096.5	-786.7	3032.6	2	30.0	304.0	0.0	-3.0
24.0	1	-57964.8	-710.7	3024.6	2	30.0	304.0	0.0	-3.0
24.5	1	-57833.2	-634.7	3016.6	2	30.0	304.0	0.0	-3.0
25.0	1	-57701.6	-558.7	3008.7	2	30.0	304.0	0.0	-3.0
25.5	1	-57569.9	-482.7	3000.7	2	30.0	304.0	0.0	-3.0
26.0	1	-57438.3	-406.7	2992.8	2	30.0	304.0	0.0	-3.0
26.5	1	-57306.6	-330.7	2984.8	2	30.0	304.0	0.0	-3.0
27.0	1	-57175.0	-254.7	2976.9	2	30.0	304.0	0.0	-3.0
27.5	1	-57043.3	-178.7	2968.9	2	30.0	304.0	0.0	-3.0
28.0	1	-56911.7	-102.7	2961.0	2	30.0	304.0	0.0	-3.0
28.5	1	-56780.1	-26.7	2953.0	2	30.0	304.0	0.0	-3.0
29.0	1	-56648.4	49.3	2945.1	2	30.0	304.0	0.0	-3.0
29.5	1	-56516.8	125.3	2937.1	2	30.0	304.0	0.0	-3.0
30.0	1	-56385.1	201.3	2929.1	2	30.0	304.0	0.0	-3.0
30.5	1	-56253.5	277.3	2921.2	2	30.0	304.0	0.0	-3.0
31.0	1	-56121.9	353.3	2913.2	2	30.0	304.0	0.0	-3.0
31.5	1	-55990.2	429.3	2905.3	2	30.0	304.0	0.0	-3.0
32.0	1	-55858.6	505.3	2897.3	2	30.0	304.0	0.0	-3.0
32.5	1	-55726.9	581.3	2889.4	2	30.0	304.0	0.0	-3.0
33.0	1	-55595.3	657.3	2881.4	2	30.0	304.0	0.0	-3.0
33.5	1	-55463.7	733.3	2873.5	2	30.0	304.0	0.0	-3.0
34.0	1	-55332.0	809.3	2865.5	2	30.0	304.0	0.0	-3.0

34.5	1	-55200.4	885.3	2857.5	2	30.0	304.0	0.0	-3.0
35.0	1	-55068.7	961.3	2849.6	2	30.0	304.0	0.0	-3.0
35.5	1	-54937.1	1037.3	2841.6	2	30.0	304.0	0.0	-3.0
36.0	1	-54805.5	1113.3	2833.7	2	30.0	304.0	0.0	-3.0
36.5	1	-54673.8	1189.3	2825.7	2	30.0	304.0	0.0	-3.0
37.0	1	-54542.2	1265.3	2817.8	2	30.0	304.0	0.0	-3.0
37.5	1	-54410.5	1341.3	2809.8	2	30.0	304.0	0.0	-3.0
38.0	1	-54278.9	1417.3	2801.9	2	30.0	304.0	0.0	-3.0
38.5	1	-54147.3	1493.3	2793.9	2	30.0	304.0	0.0	-3.0
39.0	1	-54015.6	1569.3	2786.0	2	30.0	304.0	0.0	-3.0
39.5	1	-53884.0	1645.3	2778.0	2	30.0	304.0	0.0	-3.0
40.0	1	-53752.3	1721.3	2770.0	2	30.0	304.0	0.0	-3.0
40.5	1	-53620.7	1797.3	2762.1	2	30.0	304.0	0.0	-3.0
41.0	1	-53489.1	1873.3	2754.1	2	30.0	304.0	0.0	-3.0
41.5	1	-53357.4	1949.3	2746.2	2	30.0	304.0	0.0	-3.0
42.0	1	-53225.8	2025.3	2738.2	2	30.0	304.0	0.0	-3.0
42.5	1	-53094.1	2101.3	2730.3	2	30.0	304.0	0.0	-3.0
43.0	1	-52962.5	2177.4	2722.3	2	30.0	304.0	0.0	-3.0
43.5	1	-52830.8	2253.4	2714.4	2	30.0	304.0	0.0	-3.0
44.0	1	-52699.2	2329.4	2706.4	2	30.0	304.0	0.0	-3.0
44.5	1	-52567.6	2405.4	2698.4	2	30.0	304.0	0.0	-3.0
45.0	1	-52435.9	2481.4	2690.5	2	30.0	304.0	0.0	-3.0
45.5	1	-52304.3	2557.4	2682.5	2	30.0	304.0	0.0	-3.0
46.0	1	-52172.6	2633.4	2674.6	2	30.0	304.0	0.0	-3.0
46.5	1	-52041.0	2709.4	2666.6	2	30.0	304.0	0.0	-3.0
47.0	1	-51909.4	2785.4	2658.7	2	30.0	304.0	0.0	-3.0
47.5	1	-51777.7	2861.4	2650.7	2	30.0	304.0	0.0	-3.0
48.0	1	-51646.1	2937.4	2642.8	2	30.0	304.0	0.0	-3.0
48.5	1	-51514.4	3013.4	2634.8	2	30.0	304.0	0.0	-3.0
49.0	1	-51382.8	3089.4	2626.9	2	30.0	304.0	0.0	-3.0
49.5	1	-51251.2	3165.4	2618.9	2	30.0	304.0	0.0	-3.0
50.0	1	-51119.5	3241.4	2610.9	2	30.0	304.0	0.0	-3.0
50.5	1	-50987.9	3317.4	2603.0	2	30.0	304.0	0.0	-3.0
51.0	1	-50856.2	3393.4	2595.0	2	30.0	304.0	0.0	-3.0
51.5	1	-50724.6	3469.4	2587.1	2	30.0	304.0	0.0	-3.0
52.0	1	-50593.0	3545.4	2579.1	2	30.0	304.0	0.0	-3.0
52.5	1	-50461.3	3621.4	2571.2	2	30.0	304.0	0.0	-3.0
53.0	1	-50329.7	3697.4	2563.2	2	30.0	304.0	0.0	-3.0
53.5	1	-50198.0	3773.4	2555.3	2	30.0	304.0	0.0	-3.0
54.0	1	-50066.4	3849.4	2547.3	2	30.0	304.0	0.0	-3.0
54.5	1	-49934.8	3925.4	2539.3	2	30.0	304.0	0.0	-3.0
55.0	1	-49803.1	4001.4	2531.4	2	30.0	304.0	0.0	-3.0
55.5	1	-49671.5	4077.4	2523.4	2	30.0	304.0	0.0	-3.0
56.0	1	-49539.8	4153.4	2515.5	2	30.0	304.0	0.0	-3.0
56.5	1	-49408.2	4229.4	2507.5	2	30.0	304.0	0.0	-3.0
57.0	1	-49276.6	4305.4	2499.6	2	30.0	304.0	0.0	-3.0
57.5	1	-49144.9	4381.4	2491.6	2	30.0	304.0	0.0	-3.0
58.0	1	-49013.3	4457.4	2483.7	2	30.0	304.0	0.0	-3.0
58.5	1	-48881.6	4533.4	2475.7	2	30.0	304.0	0.0	-3.0
59.0	1	-48750.0	4609.4	2467.7	2	30.0	304.0	0.0	-3.0
59.5	1	-48618.3	4685.4	2459.8	2	30.0	304.0	0.0	-3.0
60.0	1	-48486.7	4761.4	2451.8	2	30.0	304.0	0.0	-3.0
60.5	1	-48355.1	4837.4	2443.9	2	30.0	304.0	0.0	-3.0
61.0	1	-48223.4	4913.4	2435.9	2	30.0	304.0	0.0	-3.0
61.5	1	-48091.8	4989.4	2428.0	2	30.0	304.0	0.0	-3.0
62.0	1	-47960.1	5065.4	2420.0	2	30.0	304.0	0.0	-3.0
62.5	1	-47828.5	5141.4	2412.1	2	30.0	304.0	0.0	-3.0
63.0	1	-47696.9	5217.4	2404.1	2	30.0	304.0	0.0	-3.0
63.5	1	-47565.2	5293.4	2396.2	2	30.0	304.0	0.0	-3.0
64.0	1	-47433.6	5369.4	2388.2	2	30.0	304.0	0.0	-3.0
64.5	1	-47301.9	5445.4	2380.2	2	30.0	304.0	0.0	-3.0
65.0	1	-47170.3	5521.4	2372.3	2	30.0	304.0	0.0	-3.0
65.5	1	-47038.7	5597.4	2364.3	2	30.0	304.0	0.0	-3.0
66.0	1	-46907.0	5673.4	2356.4	2	30.0	304.0	0.0	-3.0
66.5	1	-46775.4	5749.4	2348.4	2	30.0	304.0	0.0	-3.0
67.0	1	-46643.7	5825.4	2340.5	2	30.0	304.0	0.0	-3.0
67.5	1	-46512.1	5901.4	2332.5	2	30.0	304.0	0.0	-3.0
68.0	1	-46380.5	5977.4	2324.6	2	30.0	304.0	0.0	-3.0
68.5	1	-46248.8	6053.4	2316.6	2	30.0	304.0	0.0	-3.0
69.0	1	-46117.2	6129.4	2308.6	2	30.0	304.0	0.0	-3.0
69.5	1	-45985.5	6205.4	2300.7	2	30.0	304.0	0.0	-3.0
70.0	1	-45853.9	6281.4	2292.7	2	30.0	304.0	0.0	-3.0

70.5	1	-45722.3	6357.4	2284.8	2	30.0	304.0	0.0	-3.0
71.0	1	-45590.6	6433.4	2276.8	2	30.0	304.0	0.0	-3.0
71.5	1	-45459.0	6509.4	2268.9	2	30.0	304.0	0.0	-3.0
72.0	1	-45327.3	6585.4	2260.9	2	30.0	304.0	0.0	-3.0
72.5	1	-45195.7	6661.4	2253.0	2	30.0	304.0	0.0	-3.0
73.0	1	-45064.1	6737.4	2245.0	2	30.0	304.0	0.0	-3.0
73.5	1	-44932.4	6813.4	2237.1	2	30.0	304.0	0.0	-3.0
74.0	1	-44800.8	6889.4	2229.1	2	30.0	304.0	0.0	-3.0
74.5	1	-44669.1	6965.4	2221.1	2	30.0	304.0	0.0	-3.0
75.0	1	-44537.5	7041.4	2213.2	2	30.0	304.0	0.0	-3.0
75.5	1	-44405.8	7117.4	2205.2	2	30.0	304.0	0.0	-3.0
76.0	1	-44274.2	7193.4	2197.3	2	30.0	304.0	0.0	-3.0
76.5	1	-44142.6	7269.4	2189.3	2	30.0	304.0	0.0	-3.0

*ESA
run1
*FLOAT

T1	RWY_1isL	X1	Y1	Z1	LEG1	HEAD1	V1	BANK1	SLOPE1
0.5	1	-64850.1	-1929.3	3398.6	1	0.2	299.9	0.0	-3.0
1.0	1	-64700.1	-1928.8	3390.8	1	0.2	299.9	0.0	-3.0
1.5	1	-64550.2	-1928.2	3382.9	1	0.2	299.9	0.0	-3.0
2.0	1	-64400.3	-1927.7	3375.1	1	0.2	299.9	0.0	-3.0
2.5	1	-64250.3	-1927.2	3367.2	1	0.2	299.9	0.0	-3.0
3.0	1	-64100.4	-1926.6	3359.4	1	0.2	299.9	0.0	-3.0
3.5	1	-63950.4	-1926.1	3351.5	1	0.2	299.9	0.0	-3.0
4.0	1	-63800.5	-1925.6	3343.7	1	0.2	299.9	0.0	-3.0
4.5	1	-63650.6	-1925.0	3335.8	1	0.2	299.9	0.0	-3.0
5.0	1	-63500.6	-1924.5	3328.0	1	0.2	299.9	0.0	-3.0

TABLE B3.-AC_2.track Output File

*ESA
run1
*FLOAT

T2	RWY_2isR	X2	Y2	Z2	LEG2	HEAD2	V2	BANK2	SLOPE2
0.5	2	-62374.2	1830.8	3268.8	1	-0.1	251.6	0.0	-3.0
1.0	2	-62248.4	1830.6	3262.3	1	-0.1	251.6	0.0	-3.0
1.5	2	-62122.7	1830.3	3255.7	1	-0.1	251.6	0.0	-3.0
2.0	2	-61996.9	1830.0	3249.1	1	-0.1	251.6	0.0	-3.0
2.5	2	-61871.1	1829.8	3242.5	1	-0.1	251.6	0.0	-3.0
3.0	2	-61745.3	1829.5	3235.9	1	-0.1	251.6	0.0	-3.0
3.5	2	-61619.5	1829.2	3229.4	1	-0.1	251.6	0.0	-3.0
4.0	2	-61493.8	1829.0	3222.8	1	-0.1	251.6	0.0	-3.0
4.5	2	-61368.0	1828.7	3216.2	1	-0.1	251.6	0.0	-3.0
5.0	2	-61242.2	1828.5	3209.6	1	-0.1	251.6	0.0	-3.0
5.5	2	-61116.4	1828.2	3203.0	1	-0.1	251.6	0.0	-3.0
6.0	2	-60990.6	1827.9	3196.4	1	-0.1	251.6	0.0	-3.0
6.5	2	-60864.8	1827.7	3189.9	1	-0.1	251.6	0.0	-3.0
7.0	2	-60739.1	1827.4	3183.3	1	-0.1	251.6	0.0	-3.0
7.5	2	-60613.3	1827.1	3176.7	1	-0.1	251.6	0.0	-3.0
8.0	2	-60487.5	1826.9	3170.1	1	-0.1	251.6	0.0	-3.0
8.5	2	-60361.7	1826.6	3163.5	1	-0.1	251.6	0.0	-3.0
9.0	2	-60235.9	1826.3	3156.9	1	-0.1	251.6	0.0	-3.0
9.5	2	-60110.2	1826.1	3150.4	1	-0.1	251.6	0.0	-3.0
10.0	2	-59984.4	1825.8	3143.8	1	-0.1	251.6	0.0	-3.0
10.5	2	-59858.6	1825.6	3137.2	1	-0.1	251.6	0.0	-3.0
11.0	2	-59732.8	1825.3	3130.6	1	-0.1	251.6	0.0	-3.0
11.5	2	-59607.0	1825.0	3124.0	1	-0.1	251.6	0.0	-3.0
12.0	2	-59481.3	1824.8	3117.4	1	-0.1	251.6	0.0	-3.0
12.5	2	-59355.5	1824.5	3110.9	1	-0.1	251.6	0.0	-3.0
13.0	2	-59229.7	1824.2	3104.3	1	-0.1	251.6	0.0	-3.0
13.5	2	-59103.9	1824.0	3097.7	1	-0.1	251.6	0.0	-3.0
14.0	2	-58978.1	1823.7	3091.1	1	-0.1	251.6	0.0	-3.0
14.5	2	-58852.3	1823.4	3084.5	1	-0.1	251.6	0.0	-3.0
15.0	2	-58726.6	1823.2	3077.9	1	-0.1	251.6	0.0	-3.0
15.5	2	-58600.8	1822.9	3071.4	1	-0.1	251.6	0.0	-3.0
16.0	2	-58475.0	1822.6	3064.8	1	-0.1	251.6	0.0	-3.0
16.5	2	-58349.2	1822.4	3058.2	1	-0.1	251.6	0.0	-3.0
17.0	2	-58223.4	1822.1	3051.6	1	-0.1	251.6	0.0	-3.0
17.5	2	-58097.7	1821.9	3045.0	1	-0.1	251.6	0.0	-3.0
18.0	2	-57971.9	1821.6	3038.5	1	-0.1	251.6	0.0	-3.0
18.5	2	-57846.1	1821.3	3031.9	1	-0.1	251.6	0.0	-3.0
19.0	2	-57720.3	1821.1	3025.3	1	-0.1	251.6	0.0	-3.0
19.5	2	-57594.5	1820.8	3018.7	1	-0.1	251.6	0.0	-3.0
20.0	2	-57468.8	1820.5	3012.1	1	-0.1	251.6	0.0	-3.0
20.5	2	-57343.0	1820.3	3005.5	1	-0.1	251.6	0.0	-3.0
21.0	2	-57217.2	1820.0	2999.0	1	-0.1	251.6	0.0	-3.0
21.5	2	-57091.4	1819.7	2992.4	1	-0.1	251.6	0.0	-3.0
22.0	2	-56965.6	1819.5	2985.8	1	-0.1	251.6	0.0	-3.0
22.5	2	-56839.8	1819.2	2979.2	1	-0.1	251.6	0.0	-3.0
23.0	2	-56714.1	1819.0	2972.6	1	-0.1	251.6	0.0	-3.0
23.5	2	-56588.3	1818.7	2966.0	1	-0.1	251.6	0.0	-3.0
24.0	2	-56462.5	1818.4	2959.5	1	-0.1	251.6	0.0	-3.0
24.5	2	-56336.7	1818.2	2952.9	1	-0.1	251.6	0.0	-3.0
25.0	2	-56210.9	1817.9	2946.3	1	-0.1	251.6	0.0	-3.0
25.5	2	-56085.2	1817.6	2939.7	1	-0.1	251.6	0.0	-3.0
26.0	2	-55959.4	1817.4	2933.1	1	-0.1	251.6	0.0	-3.0
26.5	2	-55833.6	1817.1	2926.5	1	-0.1	251.6	0.0	-3.0
27.0	2	-55707.8	1818.5	2920.0	1	1.4	251.6	22.0	-3.0
27.5	2	-55582.1	1823.1	2913.4	1	2.8	251.6	22.0	-3.0
28.0	2	-55456.6	1830.9	2906.8	1	4.3	251.6	22.0	-3.0
28.5	2	-55331.3	1842.0	2900.2	1	5.8	251.6	22.0	-3.0
29.0	2	-55206.4	1856.3	2893.6	1	7.3	251.6	22.0	-3.0
29.5	2	-55081.8	1873.8	2887.0	1	8.7	251.6	22.0	-3.0
30.0	2	-54957.8	1894.5	2880.5	1	10.2	251.6	22.0	-3.0
30.5	2	-54834.3	1918.4	2873.9	1	11.7	251.6	22.0	-3.0
31.0	2	-54711.5	1945.5	2867.3	1	13.2	251.6	22.0	-3.0
31.5	2	-54589.4	1975.7	2860.7	1	14.6	251.6	22.0	-3.0
32.0	2	-54468.1	2009.1	2854.1	1	16.1	251.6	22.0	-3.0
32.5	2	-54347.8	2045.6	2847.6	1	17.6	251.6	22.0	-3.0
33.0	2	-54228.4	2085.1	2841.0	1	19.1	251.6	22.0	-3.0
33.5	2	-54110.1	2127.8	2834.4	1	20.6	251.6	22.0	-3.0
34.0	2	-53992.9	2173.5	2827.8	1	22.0	251.6	22.0	-3.0

34.5	2	-53876.9	2222.1	2821.2	1	23.5	251.6	22.0	-3.0
35.0	2	-53762.2	2273.8	2814.6	1	25.0	251.6	22.0	-3.0
35.5	2	-53648.9	2328.4	2808.1	1	26.5	251.6	22.0	-3.0
36.0	2	-53537.1	2385.9	2801.5	1	27.9	251.6	22.0	-3.0
36.5	2	-53426.7	2446.2	2794.9	1	29.4	251.6	22.0	-3.0
37.0	2	-53318.0	2509.4	2788.3	1	30.9	251.6	22.0	-3.0
37.5	2	-53210.9	2575.4	2781.7	1	32.4	251.6	22.0	-3.0
38.0	2	-53105.5	2644.1	2775.1	1	33.8	251.6	22.0	-3.0
38.5	2	-53002.0	2715.5	2768.6	1	35.3	251.6	22.0	-3.0
39.0	2	-52900.3	2789.5	2762.0	1	36.8	251.6	22.0	-3.0
39.5	2	-52800.6	2866.1	2755.4	1	38.3	251.6	22.0	-3.0
40.0	2	-52702.9	2945.3	2748.8	1	39.8	251.6	22.0	-3.0
40.5	2	-52607.2	3027.0	2742.2	1	41.2	251.6	22.0	-3.0
41.0	2	-52513.7	3111.1	2735.6	1	42.7	251.6	22.0	-3.0
41.5	2	-52422.4	3197.6	2729.1	1	44.2	251.6	22.0	-3.0
42.0	2	-52333.4	3286.4	2722.5	1	45.7	251.6	22.0	-3.0
42.5	2	-52246.6	3377.5	2715.9	1	47.1	251.6	22.0	-3.0
43.0	2	-52162.3	3470.8	2709.3	1	48.6	251.6	22.0	-3.0
43.5	2	-52080.4	3566.2	2702.7	1	50.1	251.6	22.0	-3.0
44.0	2	-52000.9	3663.7	2696.1	1	51.6	251.6	22.0	-3.0
44.5	2	-51924.0	3763.3	2689.6	1	53.0	251.6	22.0	-3.0
45.0	2	-51849.7	3864.7	2683.0	1	54.5	251.6	22.0	-3.0
45.5	2	-51777.4	3967.7	2689.3	2	55.0	251.6	0.0	5.7
46.0	2	-51705.3	4070.7	2701.8	2	55.0	251.6	0.0	5.7
46.5	2	-51633.1	4173.7	2714.3	2	55.0	251.6	0.0	5.7
47.0	2	-51561.0	4276.8	2726.8	2	55.0	251.6	0.0	5.7
47.5	2	-51488.8	4379.8	2739.3	2	55.0	251.6	0.0	5.7
48.0	2	-51416.7	4482.8	2751.8	2	55.0	251.6	0.0	5.7
48.5	2	-51344.5	4585.9	2764.3	2	55.0	251.6	0.0	5.7
49.0	2	-51272.4	4688.9	2776.8	2	55.0	251.6	0.0	5.7
49.5	2	-51200.2	4791.9	2789.3	2	55.0	251.6	0.0	5.7
50.0	2	-51128.1	4895.0	2801.8	2	55.0	251.6	0.0	5.7
50.5	2	-51055.9	4998.0	2814.3	2	55.0	251.6	0.0	5.7
51.0	2	-50983.8	5101.0	2826.8	2	55.0	251.6	0.0	5.7
51.5	2	-50911.7	5204.1	2839.3	2	55.0	251.6	0.0	5.7
52.0	2	-50839.5	5307.1	2851.8	2	55.0	251.6	0.0	5.7
52.5	2	-50767.4	5410.1	2864.3	2	55.0	251.6	0.0	5.7
53.0	2	-50695.2	5513.2	2876.8	2	55.0	251.6	0.0	5.7
53.5	2	-50623.1	5616.2	2889.3	2	55.0	251.6	0.0	5.7
54.0	2	-50550.9	5719.2	2901.8	2	55.0	251.6	0.0	5.7
54.5	2	-50478.8	5822.3	2914.3	2	55.0	251.6	0.0	5.7
55.0	2	-50406.6	5925.3	2926.8	2	55.0	251.6	0.0	5.7
55.5	2	-50334.5	6028.3	2939.3	2	55.0	251.6	0.0	5.7
56.0	2	-50262.3	6131.4	2951.8	2	55.0	251.6	0.0	5.7
56.5	2	-50190.2	6234.4	2964.3	2	55.0	251.6	0.0	5.7
57.0	2	-50118.0	6337.4	2976.8	2	55.0	251.6	0.0	5.7
57.5	2	-50045.9	6440.5	2989.3	2	55.0	251.6	0.0	5.7
58.0	2	-49973.7	6543.5	3001.8	2	55.0	251.6	0.0	5.7
58.5	2	-49901.6	6646.5	3014.3	2	55.0	251.6	0.0	5.7
59.0	2	-49829.4	6749.6	3026.8	2	55.0	251.6	0.0	5.7
59.5	2	-49757.3	6852.6	3039.3	2	55.0	251.6	0.0	5.7
60.0	2	-49685.1	6955.6	3051.8	2	55.0	251.6	0.0	5.7
60.5	2	-49613.0	7058.7	3064.3	2	55.0	251.6	0.0	5.7
61.0	2	-49540.8	7161.7	3076.8	2	55.0	251.6	0.0	5.7
61.5	2	-49468.7	7264.7	3089.3	2	55.0	251.6	0.0	5.7
62.0	2	-49396.5	7367.8	3101.8	2	55.0	251.6	0.0	5.7
62.5	2	-49324.4	7470.8	3114.3	2	55.0	251.6	0.0	5.7
63.0	2	-49252.2	7573.8	3126.8	2	55.0	251.6	0.0	5.7
63.5	2	-49180.1	7676.9	3139.3	2	55.0	251.6	0.0	5.7
64.0	2	-49107.9	7779.9	3151.8	2	55.0	251.6	0.0	5.7
64.5	2	-49035.8	7882.9	3164.3	2	55.0	251.6	0.0	5.7
65.0	2	-48963.6	7986.0	3176.8	2	55.0	251.6	0.0	5.7
65.5	2	-48891.5	8089.0	3189.3	2	55.0	251.6	0.0	5.7
66.0	2	-48819.3	8192.0	3201.8	2	55.0	251.6	0.0	5.7
66.5	2	-48747.2	8295.1	3214.3	2	55.0	251.6	0.0	5.7
67.0	2	-48675.1	8398.1	3226.8	2	55.0	251.6	0.0	5.7
67.5	2	-48602.9	8501.1	3239.3	2	55.0	251.6	0.0	5.7
68.0	2	-48530.8	8604.2	3251.8	2	55.0	251.6	0.0	5.7
68.5	2	-48458.6	8707.2	3264.3	2	55.0	251.6	0.0	5.7
69.0	2	-48386.5	8810.2	3276.8	2	55.0	251.6	0.0	5.7
69.5	2	-48314.3	8913.3	3289.3	2	55.0	251.6	0.0	5.7
70.0	2	-48242.2	9016.3	3301.8	2	55.0	251.6	0.0	5.7

70.5	2	-48170.0	9119.3	3314.3	2	55.0	251.6	0.0	5.7
71.0	2	-48097.9	9222.4	3326.8	2	55.0	251.6	0.0	5.7
71.5	2	-48025.7	9325.4	3339.3	2	55.0	251.6	0.0	5.7
72.0	2	-47953.6	9428.4	3351.8	2	55.0	251.6	0.0	5.7
72.5	2	-47881.4	9531.5	3364.3	2	55.0	251.6	0.0	5.7
73.0	2	-47809.3	9634.5	3376.8	2	55.0	251.6	0.0	5.7
73.5	2	-47737.1	9737.5	3389.3	2	55.0	251.6	0.0	5.7
74.0	2	-47665.0	9840.6	3401.8	2	55.0	251.6	0.0	5.7
74.5	2	-47592.8	9943.6	3414.3	2	55.0	251.6	0.0	5.7
75.0	2	-47520.7	10046.6	3426.8	2	55.0	251.6	0.0	5.7
75.5	2	-47448.5	10149.7	3439.3	2	55.0	251.6	0.0	5.7
76.0	2	-47376.4	10252.7	3451.8	2	55.0	251.6	0.0	5.7
76.5	2	-47304.2	10355.7	3464.3	2	55.0	251.6	0.0	5.7

*ESA
run1
*FLOAT

T2	RWY_2isR	X2	Y2	Z2	LEG2	HEAD2	V2	BANK2	SLOPE2
0.5	2	-62345.6	1616.0	3267.4	1	0.1	308.8	0.0	-3.0
1.0	2	-62191.2	1616.2	3259.3	1	0.1	308.8	0.0	-3.0
1.5	2	-62036.8	1616.4	3251.2	1	0.1	308.8	0.0	-3.0
2.0	2	-61882.4	1616.7	3243.1	1	0.1	308.8	0.0	-3.0
2.5	2	-61728.0	1616.9	3235.0	1	0.1	308.8	0.0	-3.0
3.0	2	-61573.6	1617.1	3226.9	1	0.1	308.8	0.0	-3.0
3.5	2	-61419.2	1617.3	3218.9	1	0.1	308.8	0.0	-3.0
4.0	2	-61264.8	1617.5	3210.8	1	0.1	308.8	0.0	-3.0
4.5	2	-61110.4	1617.7	3202.7	1	0.1	308.8	0.0	-3.0
5.0	2	-60956.0	1617.9	3194.6	1	0.1	308.8	0.0	-3.0

TABLE B4.-Run.track Output File

*ESA
run1
*FLOAT

T0	DISTshad	DISTshad_MIN	DIST	DIST_MIN	CLOSING_RATE
0.5	4531.5	4531.5	4531.5	4531.5	30.2
1.0	4516.5	4516.5	4516.5	4516.5	30.0
1.5	4501.5	4501.5	4501.5	4501.5	29.8
2.0	4486.7	4486.7	4486.7	4486.7	29.6
2.5	4472.0	4472.0	4472.0	4472.0	29.4
3.0	4457.4	4457.4	4457.4	4457.4	29.1
3.5	4442.8	4442.8	4442.8	4442.8	28.9
4.0	4428.4	4428.4	4428.4	4428.4	28.7
4.5	4414.1	4414.1	4414.1	4414.1	28.5
5.0	4400.0	4400.0	4400.0	4400.0	28.3
5.5	4385.9	4385.9	4385.9	4385.9	28.0
6.0	4371.9	4371.9	4371.9	4371.9	27.8
6.5	4358.1	4358.1	4358.1	4358.1	27.6
7.0	4344.3	4344.3	4344.3	4344.3	27.4
7.5	4330.7	4330.7	4330.7	4330.7	27.1
8.0	4317.2	4317.2	4317.2	4317.2	26.9
8.5	4303.8	4303.8	4303.8	4303.8	26.6
9.0	4290.6	4290.6	4290.6	4290.6	26.4
9.5	4277.4	4277.4	4277.4	4277.4	26.2
10.0	4264.4	4264.4	4264.4	4264.4	25.9
10.5	4251.5	4251.5	4251.5	4251.5	25.7
11.0	4238.7	4238.7	4238.7	4238.7	25.4
11.5	4224.5	4224.5	4224.5	4224.5	31.7
12.0	4207.0	4207.0	4207.0	4207.0	38.5
12.5	4186.1	4186.1	4186.1	4186.1	45.2
13.0	4161.8	4161.8	4161.8	4161.8	51.9
13.5	4134.2	4134.2	4134.2	4134.2	58.5
14.0	4103.4	4103.4	4103.4	4103.4	65.0
14.5	4069.3	4069.3	4069.3	4069.3	71.4
15.0	4032.0	4032.0	4032.0	4032.0	77.8
15.5	3991.6	3991.6	3991.6	3991.6	84.0
16.0	3948.0	3948.0	3948.0	3948.0	90.1
16.5	3901.5	3901.5	3901.5	3901.5	96.1
17.0	3851.9	3851.9	3851.9	3851.9	102.0
17.5	3799.5	3799.5	3799.5	3799.5	107.7
18.0	3744.3	3744.3	3744.3	3744.3	113.2
18.5	3686.3	3686.3	3686.3	3686.3	118.5
19.0	3625.8	3625.8	3625.8	3625.8	123.7
19.5	3562.7	3562.7	3562.7	3562.7	128.5
20.0	3497.3	3497.3	3497.3	3497.3	133.1
20.5	3429.7	3429.7	3429.7	3429.7	137.4
21.0	3360.0	3360.0	3360.0	3360.0	141.0
21.5	3289.6	3289.6	3289.6	3289.6	140.5
22.0	3219.5	3219.5	3219.5	3219.5	139.9
22.5	3149.7	3149.7	3149.7	3149.7	139.3
23.0	3080.3	3080.3	3080.3	3080.3	138.6
23.5	3011.1	3011.1	3011.1	3011.1	137.9
24.0	2942.4	2942.4	2942.4	2942.4	137.1
24.5	2874.0	2874.0	2874.0	2874.0	136.3
25.0	2806.1	2806.1	2806.1	2806.1	135.5
25.5	2738.5	2738.5	2738.5	2738.5	134.5
26.0	2671.5	2671.5	2671.5	2671.5	133.5
26.5	2605.0	2605.0	2605.0	2605.0	132.4
27.0	2539.1	2539.1	2540.4	2540.4	131.3
27.5	2473.8	2473.8	2478.9	2478.9	130.0
28.0	2409.1	2409.1	2420.5	2420.5	128.6
28.5	2345.2	2345.2	2365.0	2365.0	127.2
29.0	2282.0	2282.0	2312.4	2312.4	125.5
29.5	2219.6	2219.6	2262.4	2262.4	123.8
30.0	2158.2	2158.2	2215.1	2215.1	121.9
30.5	2097.8	2097.8	2170.1	2170.1	119.8
31.0	2038.4	2038.4	2127.5	2127.5	117.6
31.5	1980.2	1980.2	2087.0	2087.0	115.1
32.0	1923.3	1923.3	2048.5	2048.5	112.4
32.5	1867.8	1867.8	2011.9	2011.9	109.5
33.0	1813.8	1813.8	1977.1	1977.1	106.3
33.5	1761.5	1761.5	1943.8	1943.8	102.8
34.0	1711.1	1711.1	1911.9	1911.9	99.0

34.5	1662.6	1662.6	1881.5	1881.5	94.9
35.0	1616.2	1616.2	1852.2	1852.2	90.4
35.5	1572.3	1572.3	1824.1	1824.1	85.4
36.0	1530.9	1530.9	1797.0	1797.0	80.1
36.5	1492.2	1492.2	1770.9	1770.9	74.3
37.0	1456.6	1456.6	1745.6	1745.6	68.1
37.5	1424.2	1424.2	1721.3	1721.3	61.4
38.0	1395.2	1395.2	1697.8	1697.8	54.3
38.5	1369.9	1369.9	1675.1	1675.1	46.8
39.0	1348.5	1348.5	1653.3	1653.3	38.9
39.5	1331.1	1331.1	1632.3	1632.3	30.6
40.0	1318.0	1318.0	1612.4	1612.4	22.0
40.5	1309.2	1309.2	1593.6	1593.6	13.2
41.0	1304.8	1304.8	1576.0	1576.0	4.3
41.5	1304.9	1304.8	1559.7	1559.7	-4.7
42.0	1309.5	1304.8	1545.0	1545.0	-13.6
42.5	1318.5	1304.8	1532.0	1532.0	-22.4
43.0	1331.9	1304.8	1521.0	1521.0	-31.0
43.5	1349.4	1304.8	1512.3	1512.3	-39.2
44.0	1371.0	1304.8	1506.1	1506.1	-47.2
44.5	1396.5	1304.8	1502.7	1502.7	-54.7
45.0	1425.7	1304.8	1502.5	1502.5	-61.8
45.5	1458.2	1304.8	1505.5	1502.5	-68.4
46.0	1494.0	1304.8	1511.7	1502.5	-74.6
46.5	1532.8	1304.8	1520.9	1502.5	-80.4
47.0	1574.3	1304.8	1533.1	1502.5	-85.7
47.5	1618.4	1304.8	1548.2	1502.5	-90.6
48.0	1664.8	1304.8	1566.2	1502.5	-95.1
48.5	1713.4	1304.8	1586.9	1502.5	-99.2
49.0	1764.0	1304.8	1610.3	1502.5	-103.0
49.5	1816.3	1304.8	1636.3	1502.5	-106.5
50.0	1870.4	1304.8	1664.6	1502.5	-109.7
50.5	1926.0	1304.8	1695.2	1502.5	-112.6
51.0	1982.9	1304.8	1728.0	1502.5	-115.2
51.5	2041.2	1304.8	1762.9	1502.5	-117.7
52.0	2100.6	1304.8	1799.7	1502.5	-119.9
52.5	2161.1	1304.8	1838.3	1502.5	-122.0
53.0	2222.6	1304.8	1878.6	1502.5	-123.9
53.5	2284.9	1304.8	1920.5	1502.5	-125.6
54.0	2348.2	1304.8	1963.9	1502.5	-127.2
54.5	2412.1	1304.8	2008.7	1502.5	-128.7
55.0	2476.8	1304.8	2054.8	1502.5	-130.1
55.5	2542.2	1304.8	2102.1	1502.5	-131.3
56.0	2608.2	1304.8	2150.5	1502.5	-132.5
56.5	2674.7	1304.8	2200.1	1502.5	-133.6
57.0	2741.7	1304.8	2250.6	1502.5	-134.6
57.5	2809.3	1304.8	2302.0	1502.5	-135.5
58.0	2877.2	1304.8	2354.3	1502.5	-136.4
58.5	2945.6	1304.8	2407.5	1502.5	-137.2
59.0	3014.4	1304.8	2461.3	1502.5	-137.9
59.5	3083.5	1304.8	2515.9	1502.5	-138.6
60.0	3153.0	1304.8	2571.2	1502.5	-139.3
60.5	3222.8	1304.8	2627.1	1502.5	-139.9
61.0	3292.9	1304.8	2683.5	1502.5	-140.5
61.5	3363.3	1304.8	2740.5	1502.5	-141.0
62.0	3434.0	1304.8	2798.0	1502.5	-141.5
62.5	3504.9	1304.8	2856.1	1502.5	-142.0
63.0	3576.0	1304.8	2914.5	1502.5	-142.5
63.5	3647.3	1304.8	2973.4	1502.5	-142.9
64.0	3718.9	1304.8	3032.7	1502.5	-143.3
64.5	3790.6	1304.8	3092.4	1502.5	-143.7
65.0	3862.5	1304.8	3152.4	1502.5	-144.0
65.5	3934.6	1304.8	3212.7	1502.5	-144.4
66.0	4006.9	1304.8	3273.4	1502.5	-144.7
66.5	4079.3	1304.8	3334.4	1502.5	-145.0
67.0	4151.8	1304.8	3395.7	1502.5	-145.3
67.5	4224.5	1304.8	3457.2	1502.5	-145.5
68.0	4297.4	1304.8	3519.0	1502.5	-145.8
68.5	4370.3	1304.8	3581.1	1502.5	-146.0
69.0	4443.4	1304.8	3643.3	1502.5	-146.3
69.5	4516.6	1304.8	3705.8	1502.5	-146.5
70.0	4589.9	1304.8	3768.5	1502.5	-146.7

70.5	4663.3	1304.8	3831.4	1502.5	-146.9
71.0	4736.8	1304.8	3894.5	1502.5	-147.1
71.5	4810.3	1304.8	3957.8	1502.5	-147.3
72.0	4884.0	1304.8	4021.2	1502.5	-147.4
72.5	4957.8	1304.8	4084.8	1502.5	-147.6
73.0	5031.6	1304.8	4148.5	1502.5	-147.8
73.5	5105.6	1304.8	4212.4	1502.5	-147.9
74.0	5179.6	1304.8	4276.5	1502.5	-148.1
74.5	5253.6	1304.8	4340.7	1502.5	-148.2
75.0	5327.8	1304.8	4405.0	1502.5	-148.3
75.5	5402.0	1304.8	4469.4	1502.5	-148.5
76.0	5476.3	1304.8	4533.9	1502.5	-148.6
76.5	5550.6	1304.8	4598.6	1502.5	-148.7

*ESA
run1
*FLOAT

T0	DISTshad	DISTshad_MIN	DIST	DIST_MIN	CLOSING_RATE
0.5	4342.7	4342.7	4342.7	4342.7	-4.6
1.0	4345.0	4342.7	4345.0	4342.7	-4.6
1.5	4347.3	4342.7	4347.3	4342.7	-4.6
2.0	4349.6	4342.7	4349.6	4342.7	-4.7
2.5	4352.0	4342.7	4352.0	4342.7	-4.7
3.0	4354.3	4342.7	4354.3	4342.7	-4.7
3.5	4356.6	4342.7	4356.6	4342.7	-4.7
4.0	4359.0	4342.7	4359.0	4342.7	-4.7
4.5	4361.3	4342.7	4361.3	4342.7	-4.7
5.0	4363.7	4342.7	4363.7	4342.7	-4.7

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6. AUTHOR(S)
Yaghoob S. Ebrahimi and Ken S. Chun

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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P.O. Box 3707 M/S 7X-MR
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13. ABSTRACT (*Maximum 200 words*)

This document is a user manual for operating the PLAND_BLUNDER (PLB) simulation program. This simulation is based on two aircraft approaching parallel runways independently and using parallel Instrument Landing System (ILS) equipment during Instrument Meteorological Conditions (IMC). If an aircraft should deviate from its assigned localizer course toward the opposite runway, this constitutes a *blunder* which could endanger the aircraft on the adjacent path. The worst case scenario would be if the blundering aircraft were unable to recover and continue toward the adjacent runway. PLAND_BLUNDER is a Monte Carlo-type simulation which employs the events and aircraft positioning during such a *blunder situation*.
The model simulates two aircraft performing parallel ILS approaches using IMC or visual procedures. PLB uses a simple movement model and control law in three dimensions (X, Y, Z). The parameters of the simulation inputs and outputs are defined in this document along with a sample of the statistical analysis.
This document is the second volume of a two volume set. Volume 1 is a description of the application of the PLB to the analysis of close parallel runway operations.

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