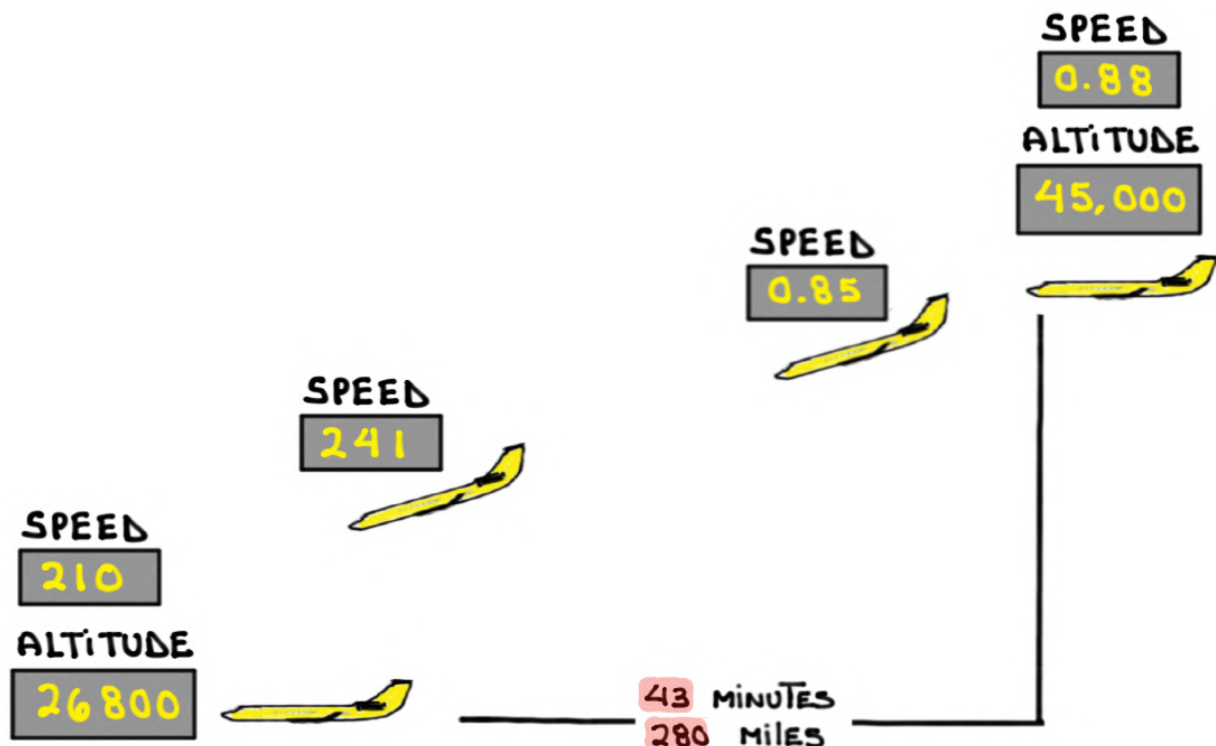


G 650

DRIFTDOWN PROCEDURES AND SYSTEMS' ASSESSMENT



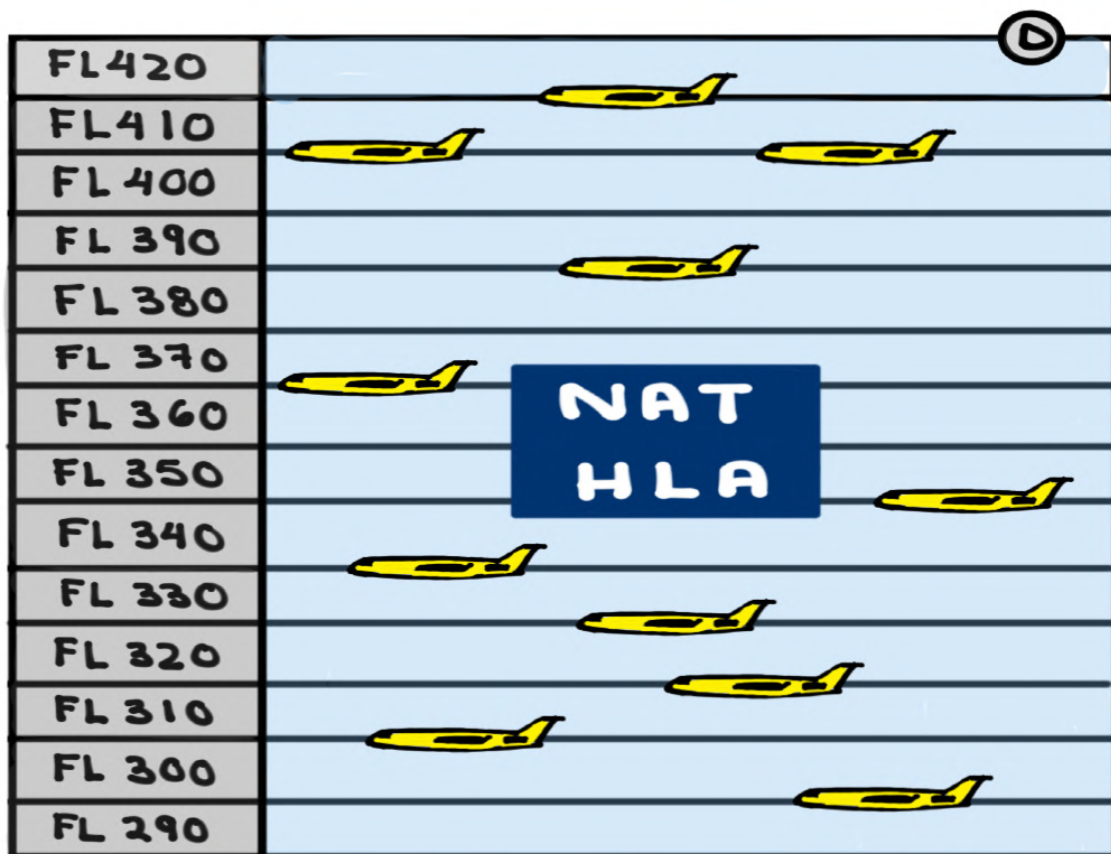
For study purposes only

PART I

NORTH ATLANTIC (NAT)

High LEVEL Airspace (HLA)

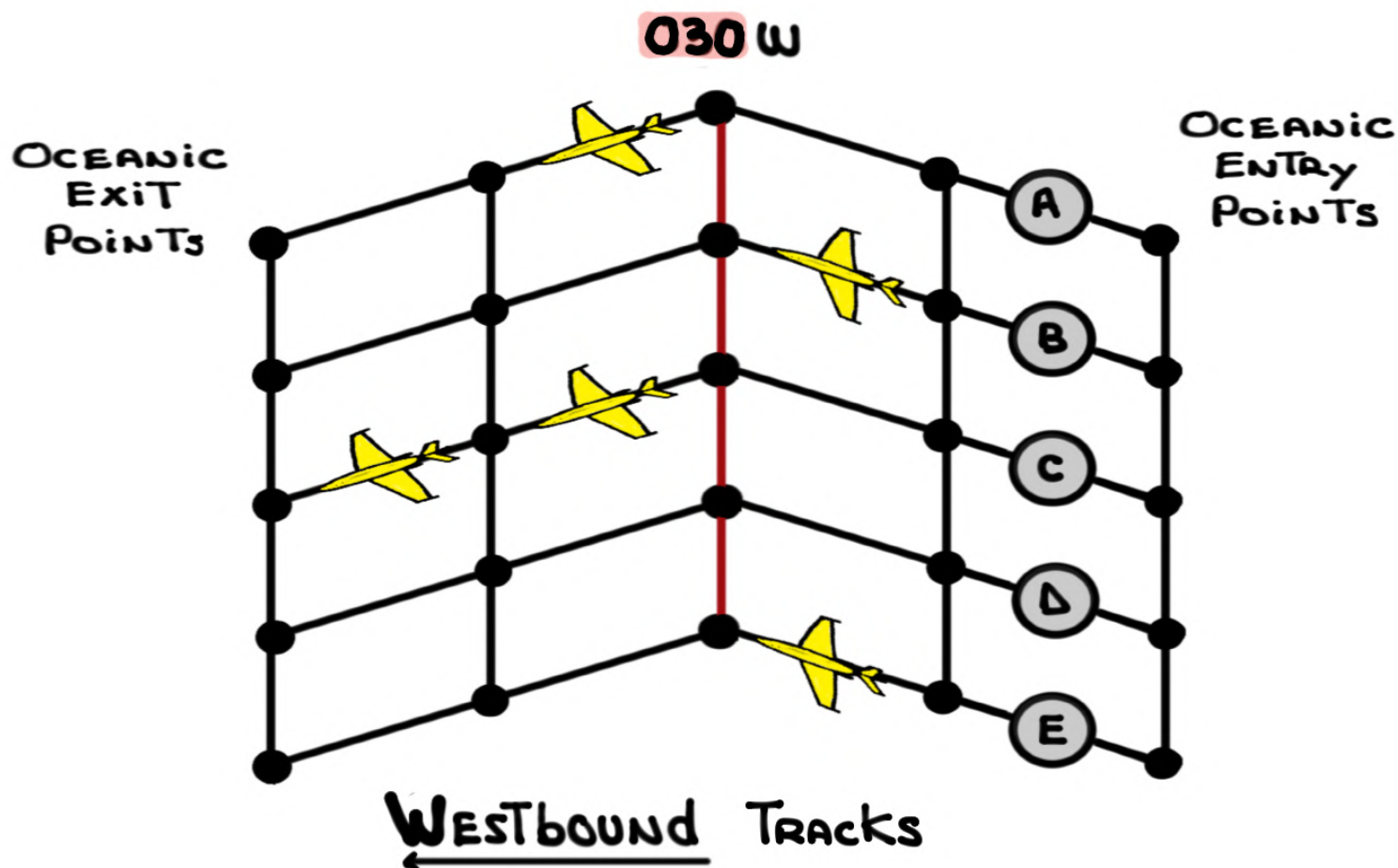
Organized Track System (OTS)



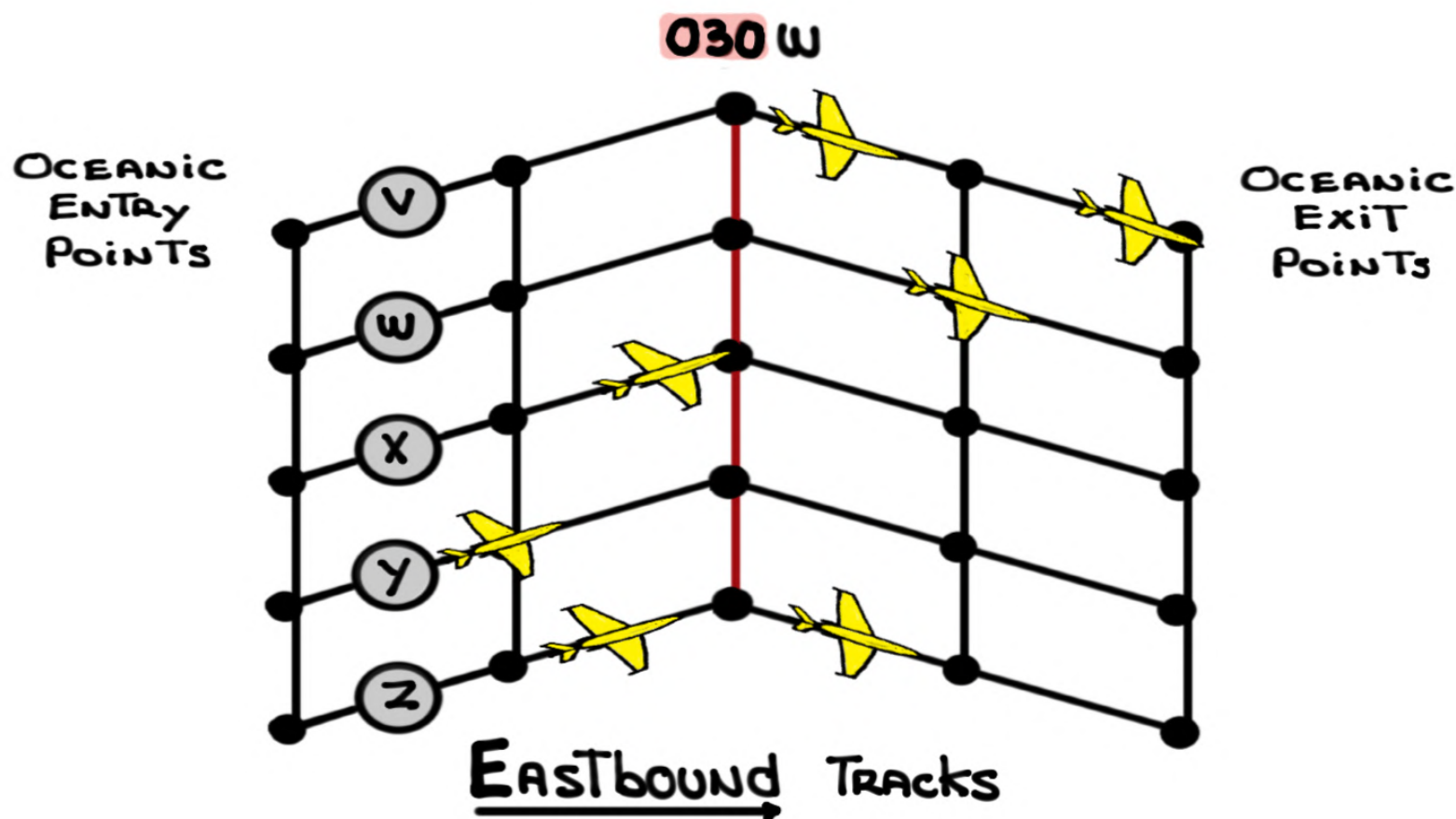
① Uni-directional and concentrated flow of Traffic between North America and Europe

② The OTS consists of two (2) major alternating flows:

- A Westbound flow departing Europe in the morning



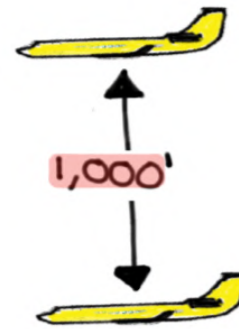
- An EASTbound flow departing North America in The EVENING



- ③ WESTbound Traffic crosses 030 W BETWEEN 1130 - 1930 Z. OTS Tracks ARE published by Shanwick AT 2200 Z
- ④ EASTbound Traffic crosses 030 W BETWEEN 0100 - 0800 Z. OTS Tracks ARE published by GANDER AT 1400 Z

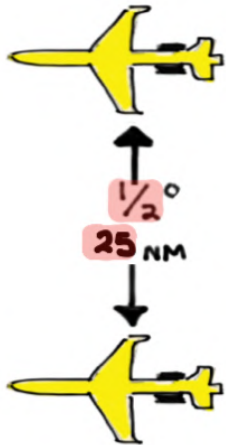
- ⑤ TRACKS ARE BASED ON MINIMUM TIME
- ⑥ A TRACK MESSAGE IDENTIFICATION (TMI) NUMBER PROVIDES OTS COORDINATES AND FLIGHT LEVELS AVAILABLE ON EACH TRACK
- ⑦ SPECIAL AUTHORIZATION, INCLUDING RVSM, IS REQUIRED
- ⑧ THE NAT'S OTS PRESENTS CONSIDERABLE CHALLENGES:
- VERY CONGESTED OCEANIC AIRSPACE WITH REDUCED VERTICAL AND HORIZONTAL SEPARATION
 - LARGE DISTANCES TO A LIMITED NUMBER OF SUITABLE ALTERNATE AIRPORTS
 - NO ATC RADAR SURVEILLANCE
 - DIRECT PILOT-CONTROLLER VOICE COMMUNICATION IS LIMITED

⑨ VERTICAL SEPARATION



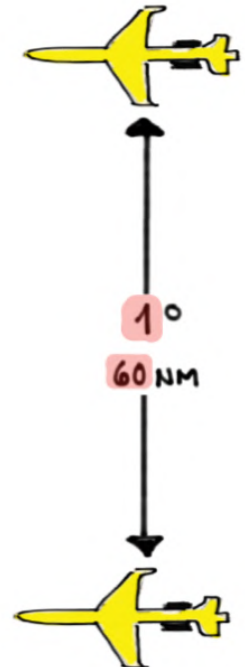
⑩ LATERAL SEPARATION

PBCS TRACK



- PERFORMANCE-BASED COMMUNICATION & SURVEILLANCE
- FL 350 - FL 390
- PBCS AUTHORIZATION REQUIRED

Non-PBCS TRACK



⑪ LONGITUDINAL SEPARATION (MACH NUMBER TECHNIQUE)



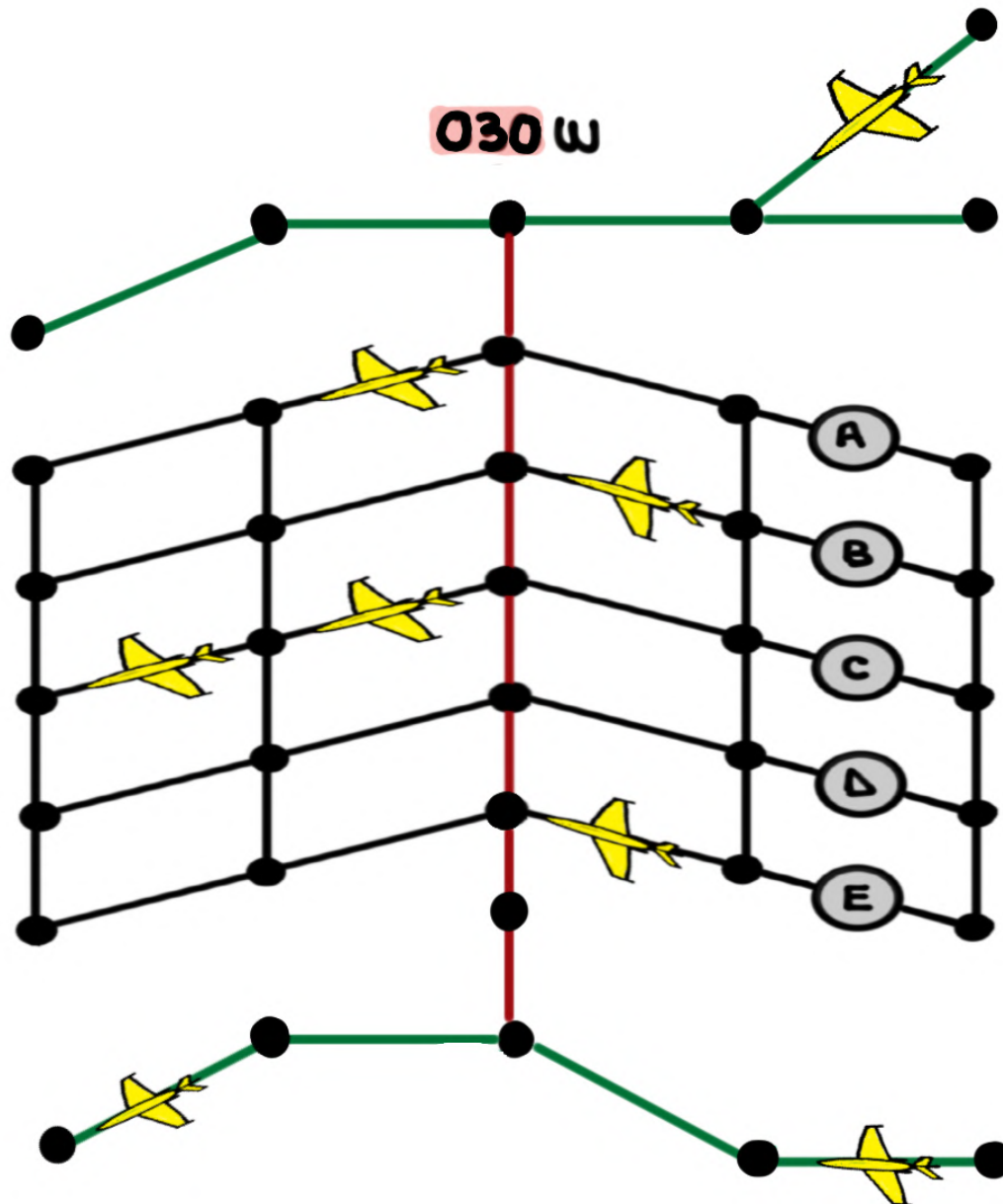
Non-PBCS TRACK



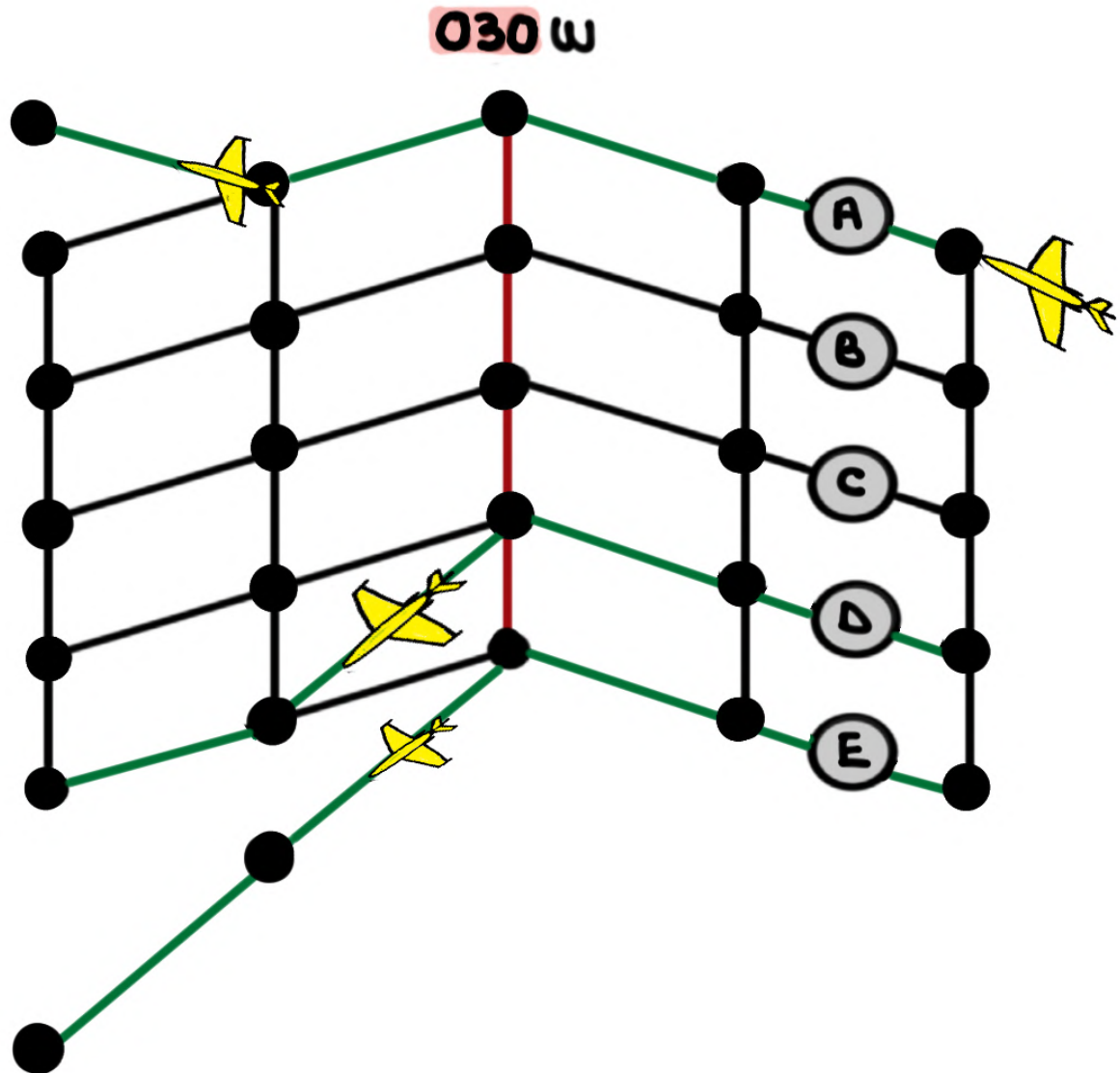
PBCS TRACK

RANDOM ROUTES

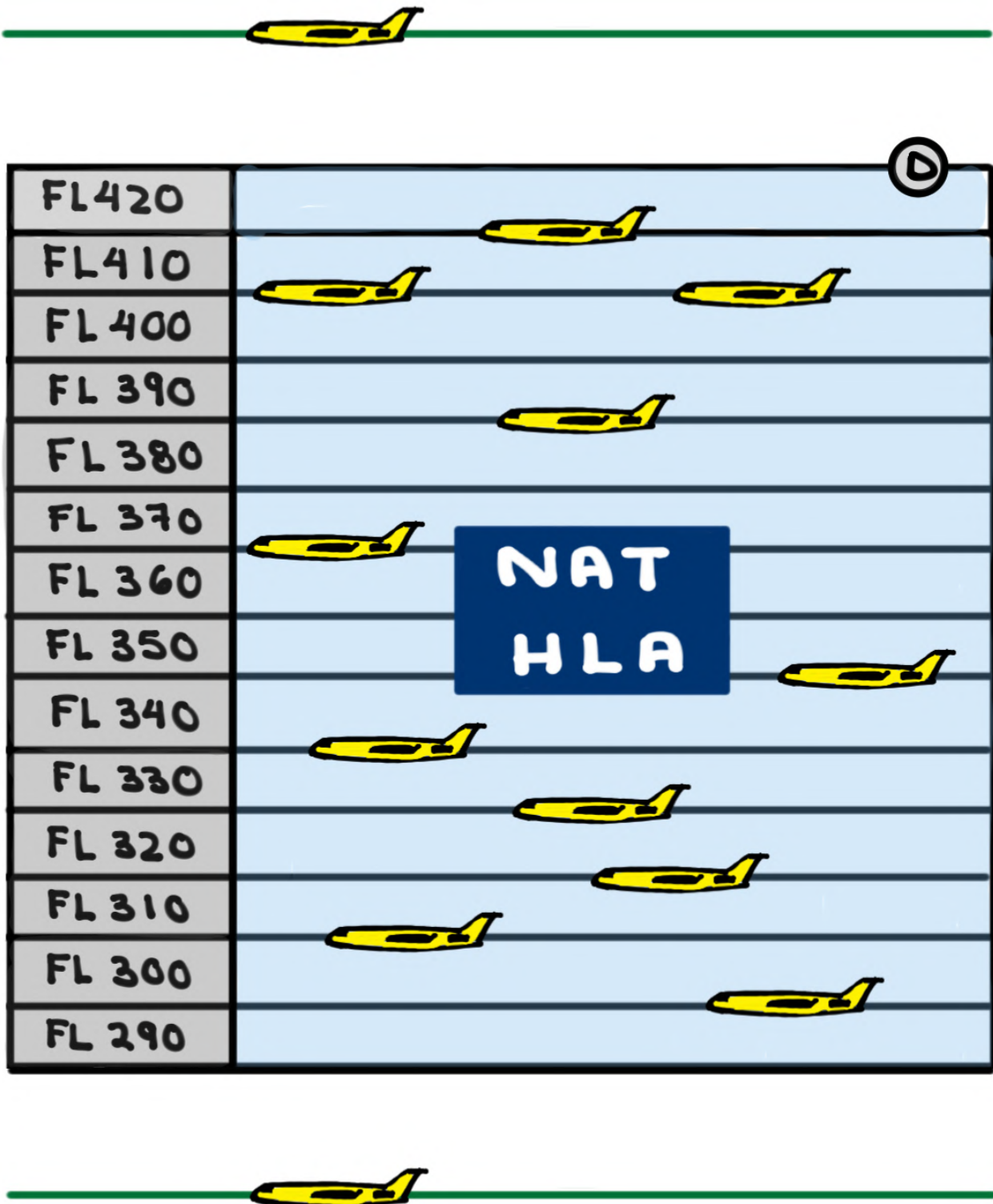
① RANDOM ROUTES ARE THOSE WHICH REMAIN CLEAR OF THE OTS





② RANDOM ROUTES CAN ALSO JOIN OR LEAVE AN OUTER TRACK OR CUT ACROSS THE OTS TRACKS

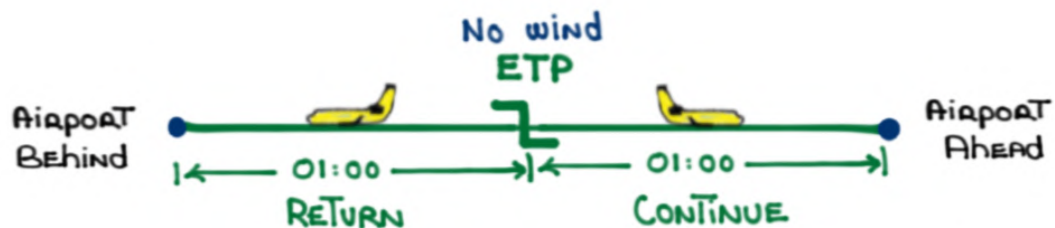


③ RANDOM ROUTES REMAIN ABOVE OR BELOW OTS TRACKS



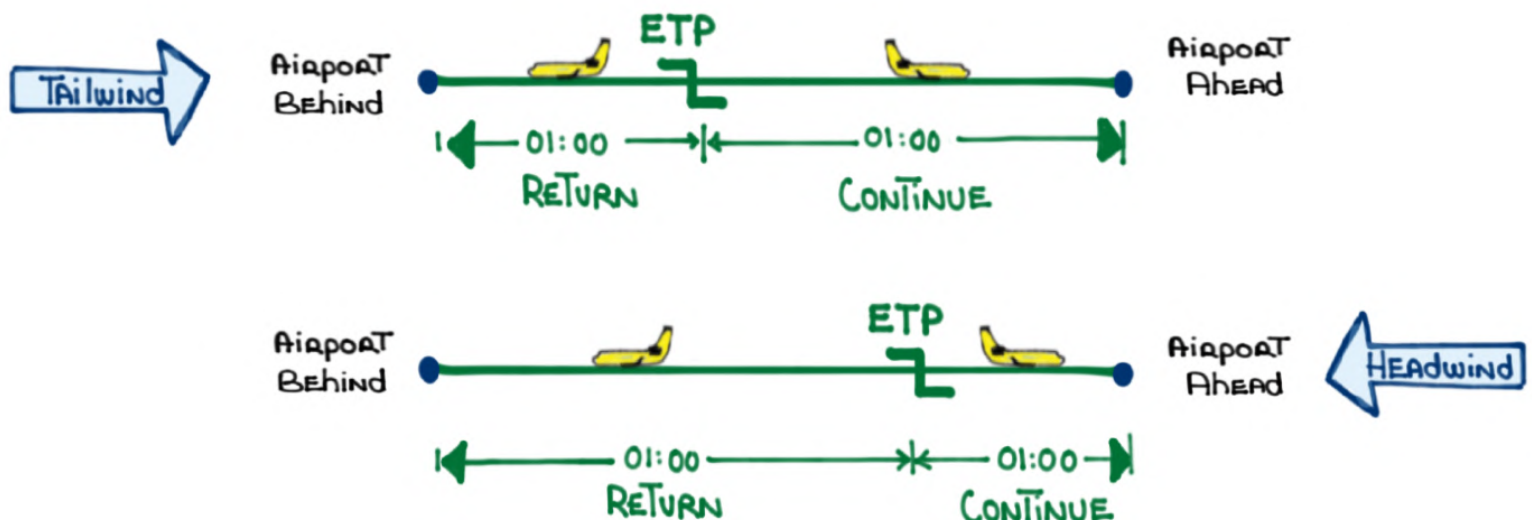
Equal Time Point (ETP)

AN **ETP** IS A GEOGRAPHICAL LOCATION ALONG THE ROUTE OF flight in which it TAKES THE SAME TIME TO CONTINUE TO THE  **Airport Ahead** AS IT DOES TO RETURN TO THE  **Airport Behind**



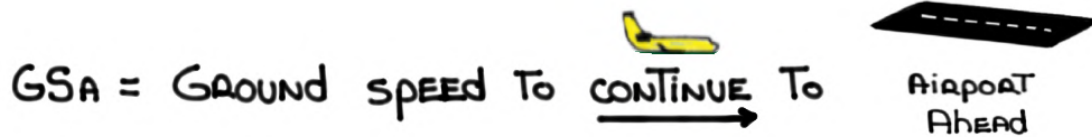
ETPs ARE ALSO REFERRED TO AS "**CRITICAL POINT**"

ETPs ARE COMPUTED FOR LONG OVERWATER flights AND ARE BASED ON GROUND SPEED (WIND FACTOR)



ETP formula:

$$\text{GROUND distance To ETP} = \frac{(D)(GS_B)}{GS_A + GS_B} = \text{NM}$$



TAS: 480 KCAS

Wind: P40 KTS

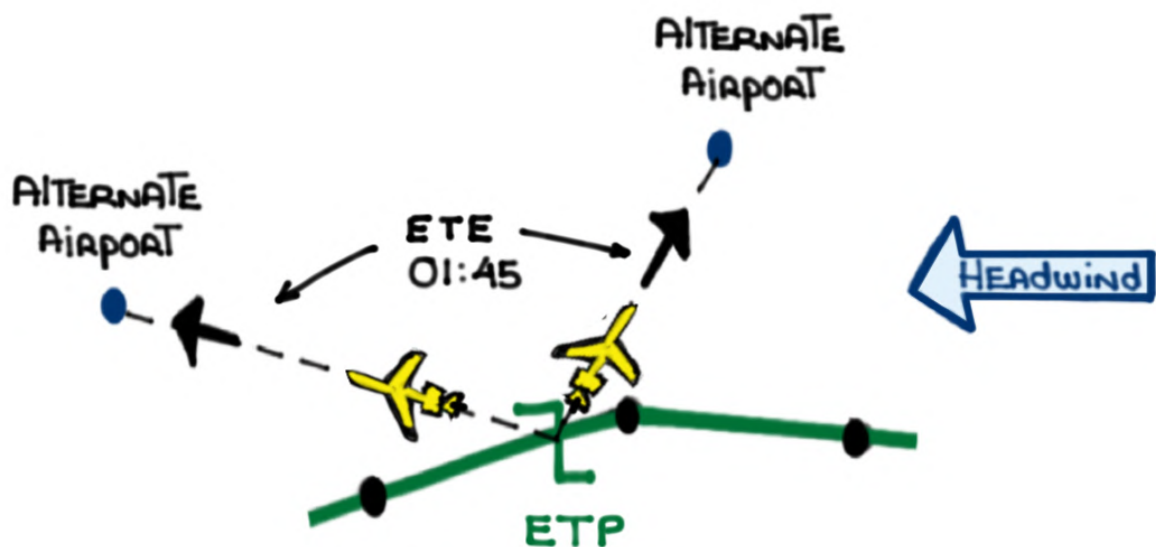
Dist: 2500 NM

GS_A: 520 KTS

GS_B: 440 KTS

$$\text{ETP} = \frac{(2500)(440)}{520 + 440} = 1146 \text{ NM}$$

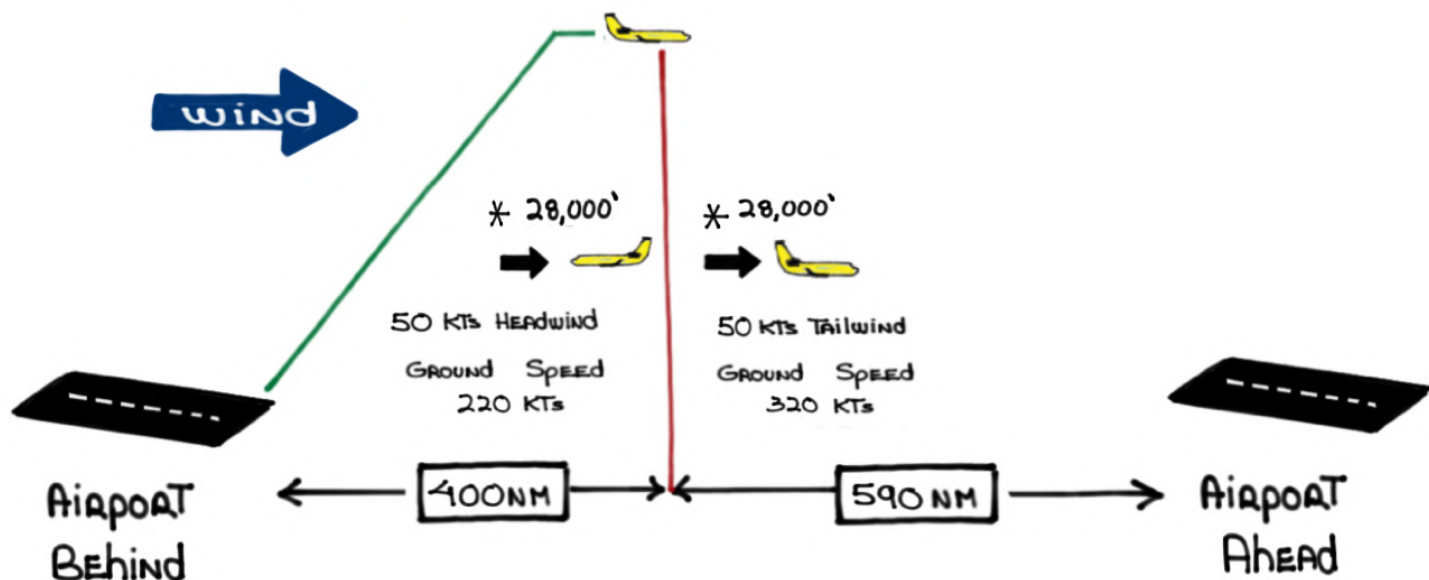
IN OCEANIC AIRSPACE **ETPs** ARE COMPUTED ALSO BETWEEN SUITABLE ALTERNATE AIRPORTS



THERE ARE THREE (3) Types of **ETPs** :

① LOSS of ENGINE **ETP** - (1E INOP)

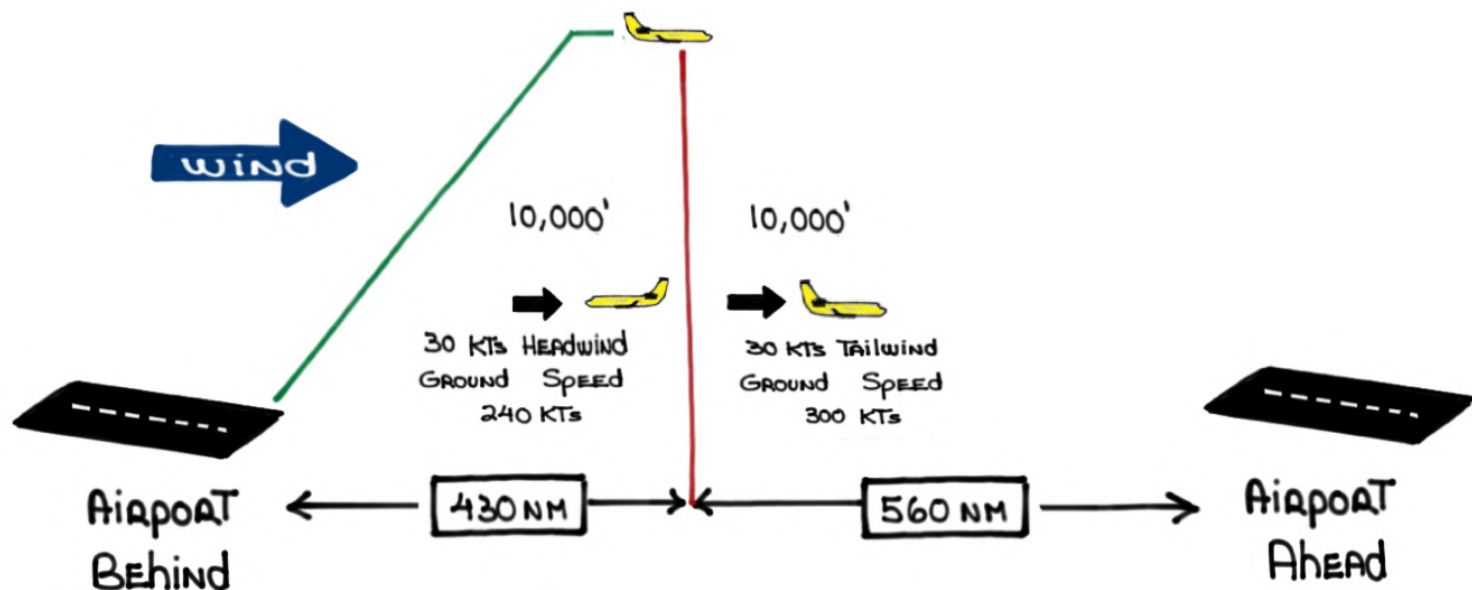
ENGINE OUT DRIFTDOWN CHARTS



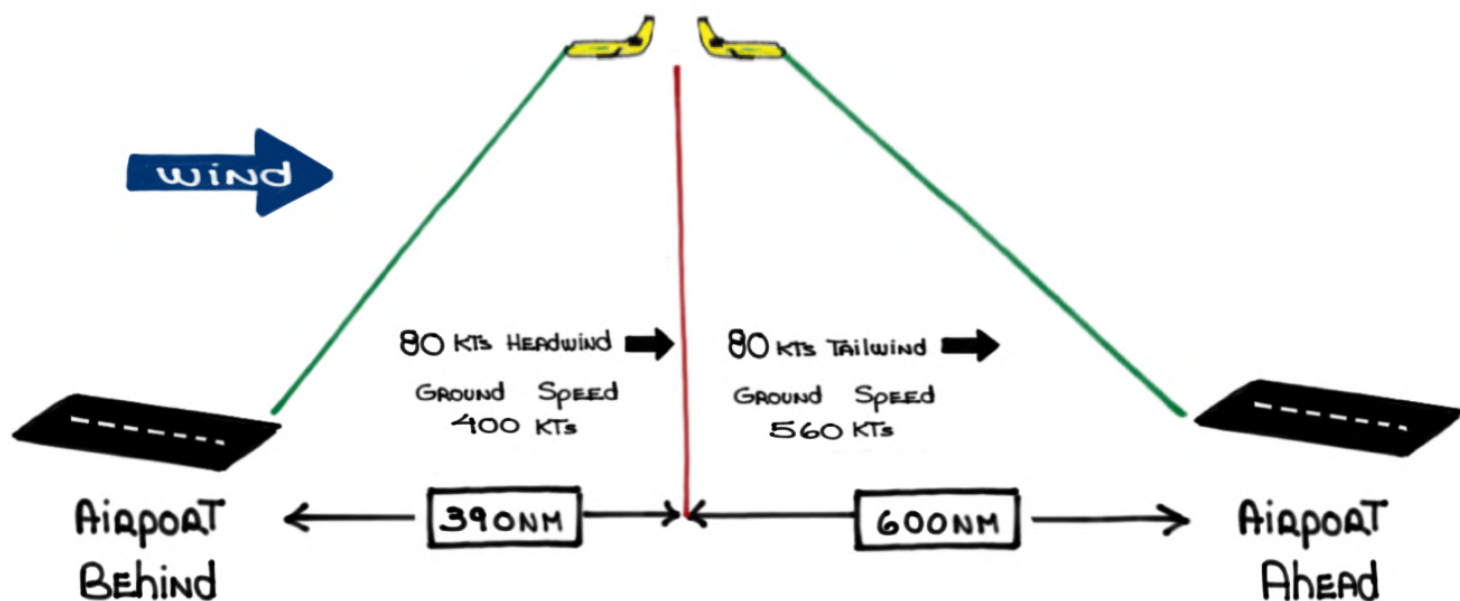
* Final driftdown ALTITUDE AS PER CHART

② Loss of level ETP - PRESSURIZATION (DEPRESS)

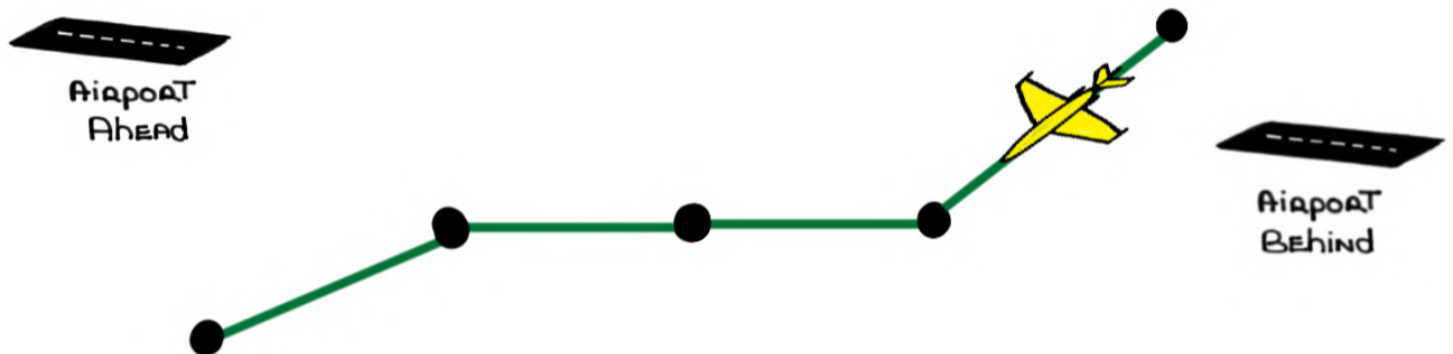
EMERGENCY DESCENT PROCEDURE



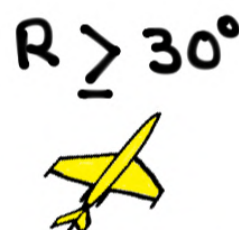
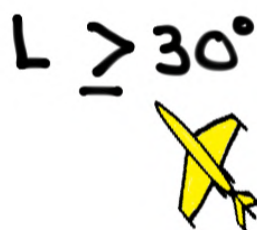
③ MAINTAIN level ETP - MEDICAL (MEDICAL)



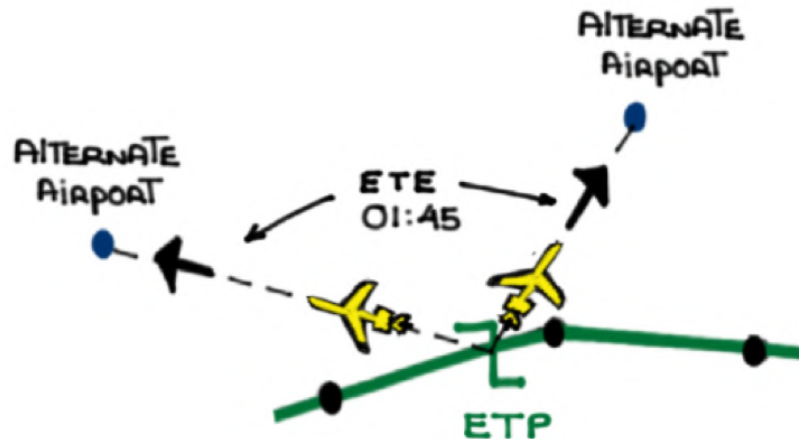
- Plot **ETPs** ON PAPER plotting chart or digital chart
- Do NOT ENTER **ETPs** INTO FMSs OTHERWISE ADS-C will SEND position reports of NON-EXISTING waypoints To ATC
- ALTERNATE AIRPORTS CAN BE AHEAD OR BEHIND AND LEFT OR RIGHT OF CURRENT POSITION



- As EACH waypoint is CROSSED MAKE A MENTAL NOTE AND BRIEF THE DIRECTION TO THE RELEVANT ALTERNATE AIRPORT. This could help you decide DIRECTION OF TURN



- **ETP** fuel calculations ASSUME A STRAIGHT line TO THE ALTERNATE AIRPORT AND DO NOT TAKE INTO ACCOUNT OTS TRACKS, WEATHER DEVIATIONS OR AN INSTRUMENT APPROACH PROCEDURE



- THE QUAD FOUR MANEUVER (DOC 4444) AND A DESCENT BELOW THE OTS TRACKS BEFORE A TURN TO THE ALTERNATE AIRPORT IS MADE WILL REQUIRE MORE FUEL
- STARTING THE APU (BACK UP AC POWER) WILL INCREASE FUEL CONSUMPTION

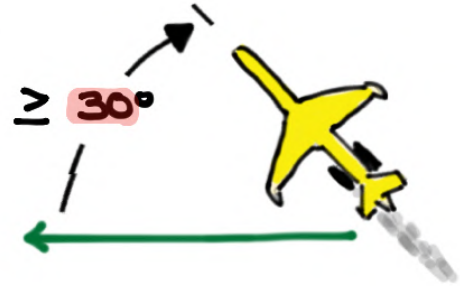
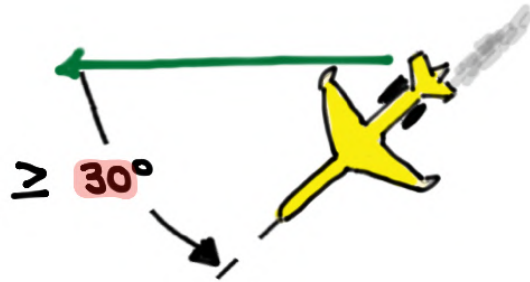
NAT OPS Bulletin 2018-005

Contingency procedures in NAT HLA airspace associated with inability to comply with assigned clearance

Special Procedures

If a revised ATC clearance CANNOT be obtained:

- 1) Turn 30° or more away from the track

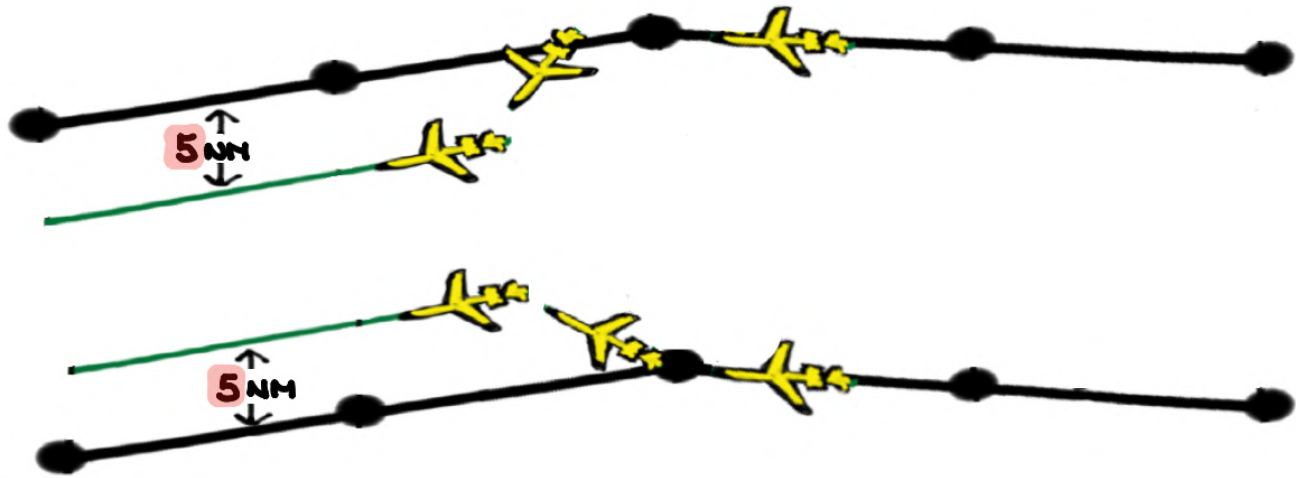


L or R?

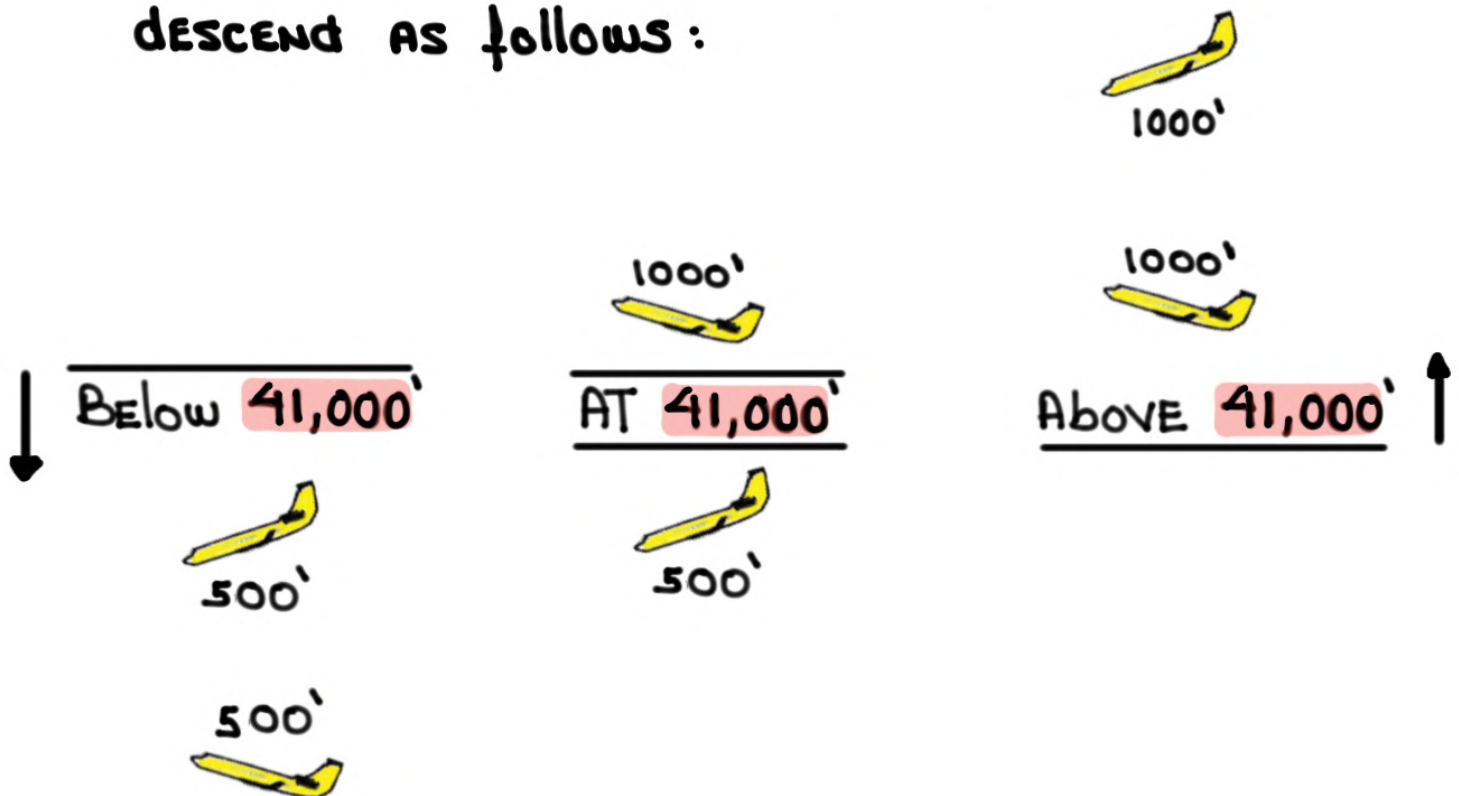
Direction of turn is based on position of aircraft in relation to other OTS tracks, direction to the alternate airport, SLOP, etc.

2) If **ABLE** To MAINTAIN ASSIGNED FLIGHT LEVEL:

A) ACQUIRE SAME DIRECTION **5 NM** OFFSET TRACK



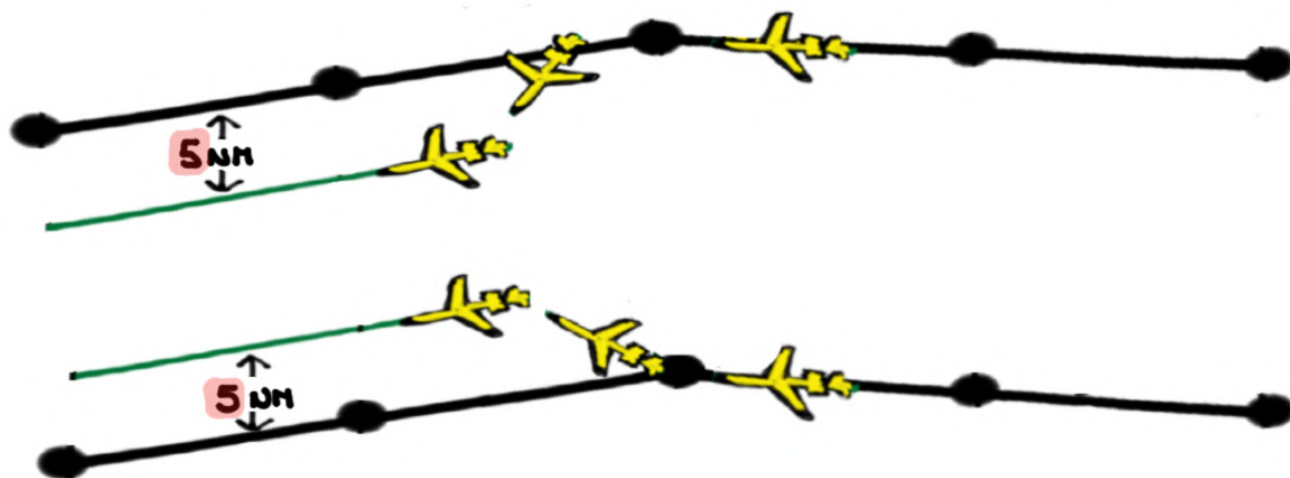
B) ONCE ESTABLISHED ON A **5 NM** OFFSET CLIMB OR DESCEND AS FOLLOWS:



3) If **UNABLE** To MAINTAIN ASSIGNED Flight LEVEL:

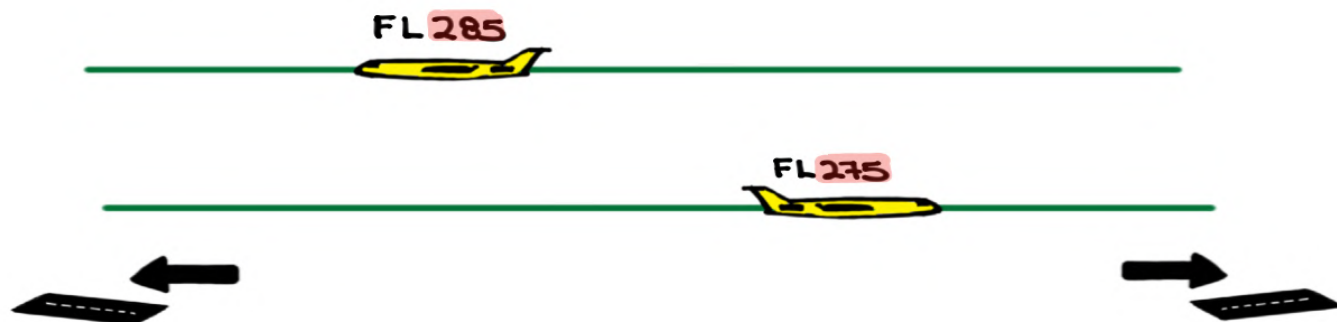
A) MINIMIZE RATE of DESCENT To what's OPERATIONALLY feasible

B) ACQUIRE SAME direction **5 NM** offset TRACK



C) DESCEND To FL **290** OR lower

D) ONCE below FL **290** ESTABLISH AND MAINTAIN A VERTICAL offset of **500'** FROM NORMAL LEVELS AND PROCEED AS REQUIRED UNTIL AN ATC CLEARANCE IS RECEIVED

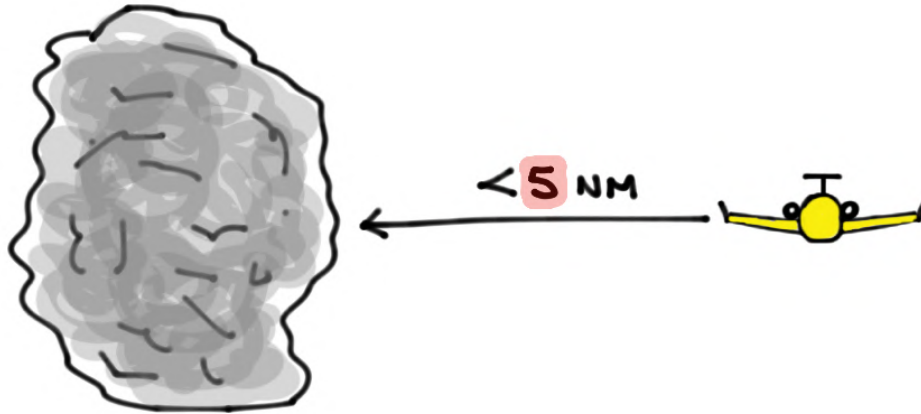


- E) ESTablish COMMUNICATION with ATC AND NEARby AIRCRAFT ON 121.5 AND 123.45 MHz
- F) TURN ON All EXTERNAL lights
- G) ENSURE TRANSPONDER is ON

DEVIATIONS AROUND SEVERE WEATHER

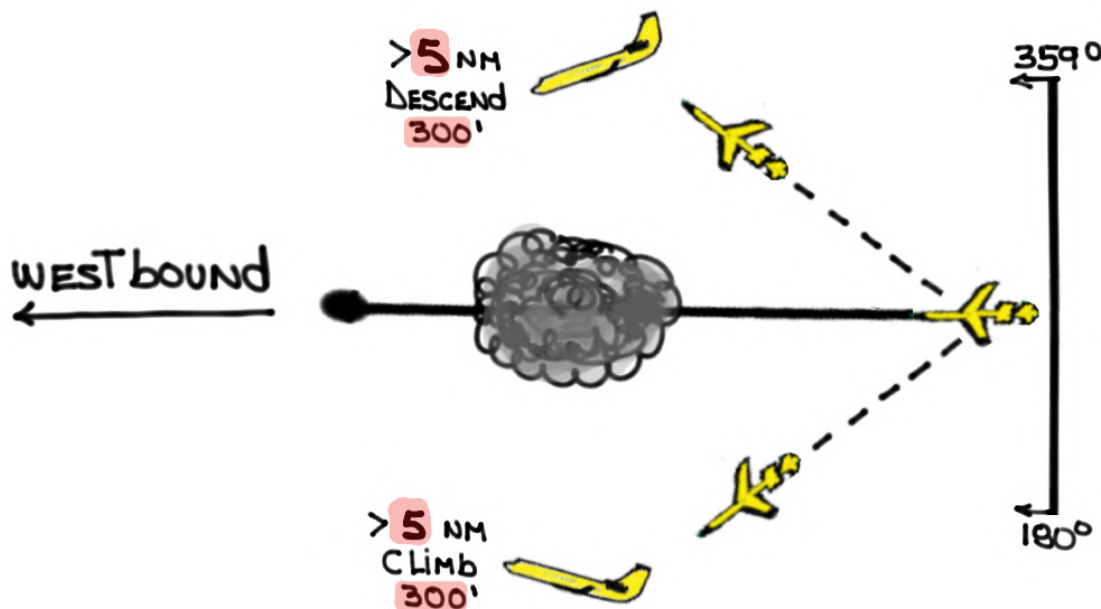
REVISED ATC CLEARANCE NOT POSSIBLE:

A) If ≤ 5 NM DEVIATION - MAINTAIN ASSIGNED FLIGHT LEVEL

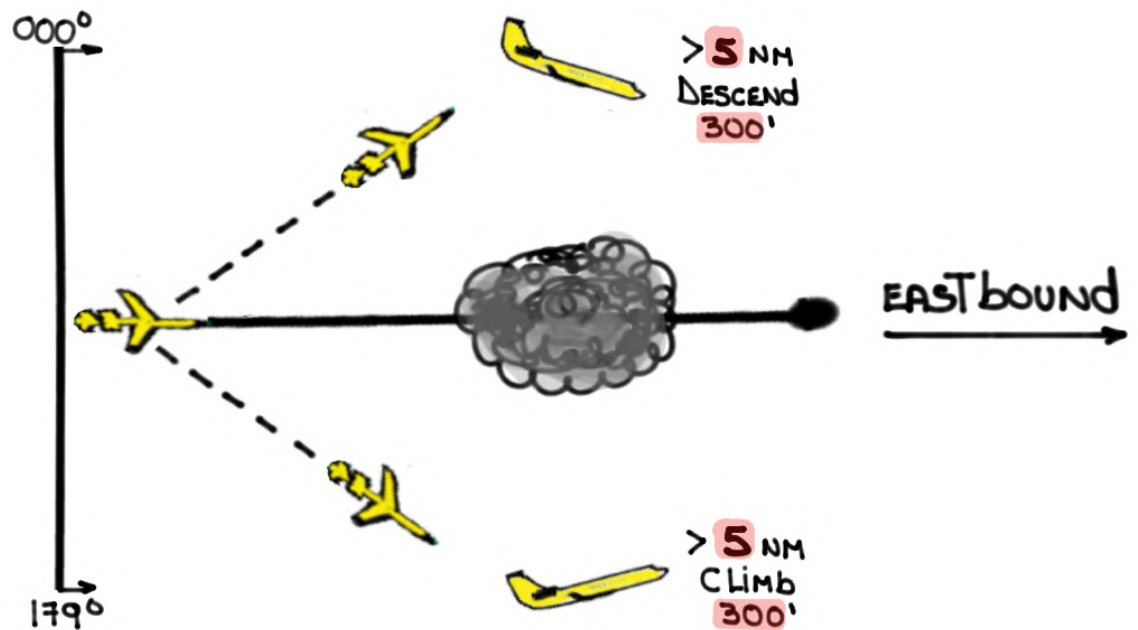


B) If > 5 NM DEVIATION - ADJUST ALTITUDE AS FOLLOWS:

"TURNING NORTH DESCEND. TURNING SOUTH CLIMB"



"TURNING NORTH descend. TURNING SOUTH climb"



SAND = South Ascend North Descend

- c) ESTablish COMMUNICATION with ATC AND NEARby AIRCRAFT ON 121.5 AND 123.45 MHz
- d) TURN ON all EXTERNAL lights
- e) ENSURE TRANSPONDER is ON

WAKE TURBULENCE

1) STRATEGIC LATERAL OFFSET PROCEDURES (SLOP)

- STANDARD OPERATING PROCEDURE THROUGHOUT NAT REGION
- SLOP AND MICRO-SLOP

2) SLOP:

- CLEARED TRACK CENTERLINE
- 1.0 NM Right of CENTERLINE
- 2.0 NM Right of CENTERLINE

3) MICRO-SLOP:

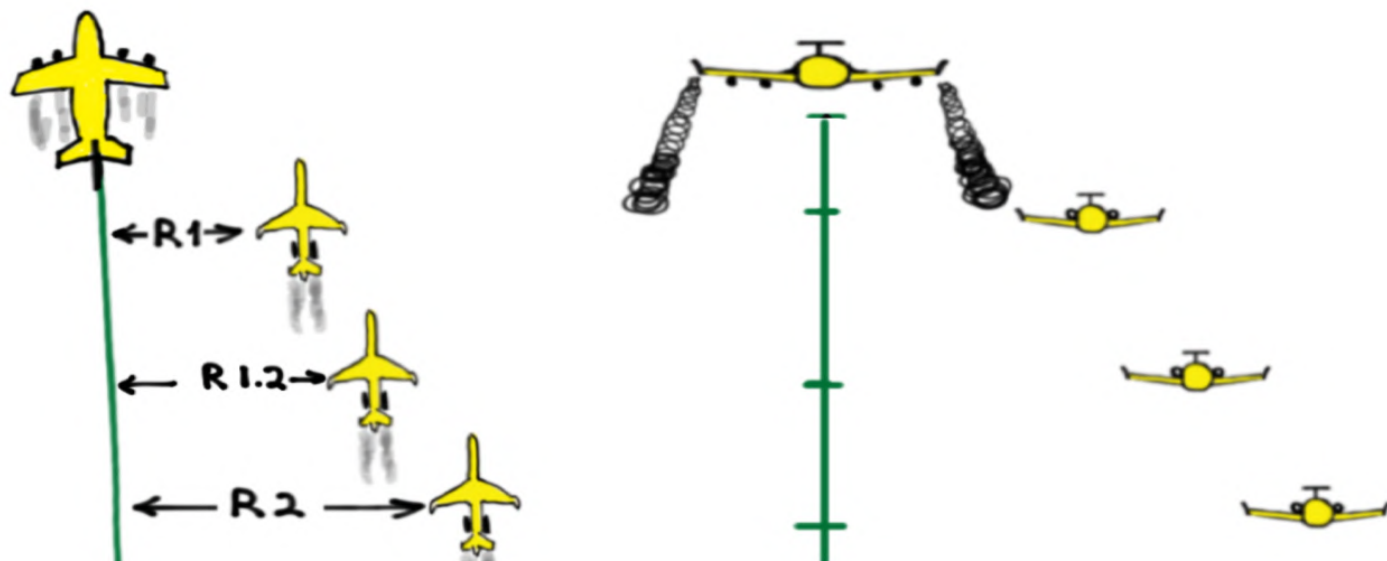
- $\frac{1}{10}$ TH NM INCREMENTS up To 2.0 NM Right of CENTERLINE

4) DO NOT SLOP ~~LEFT~~ of CENTERLINE

5) No ATC APPROVAL is REQUIRED

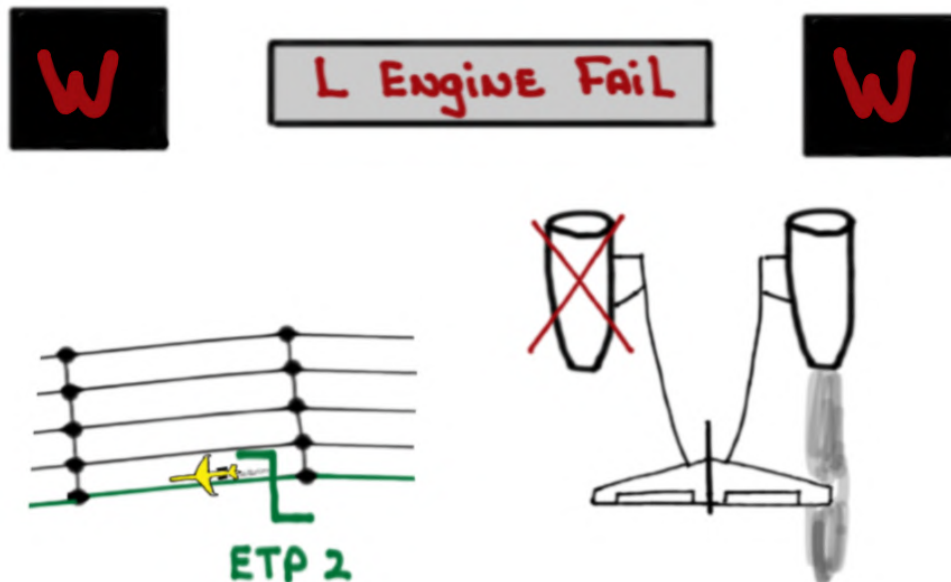
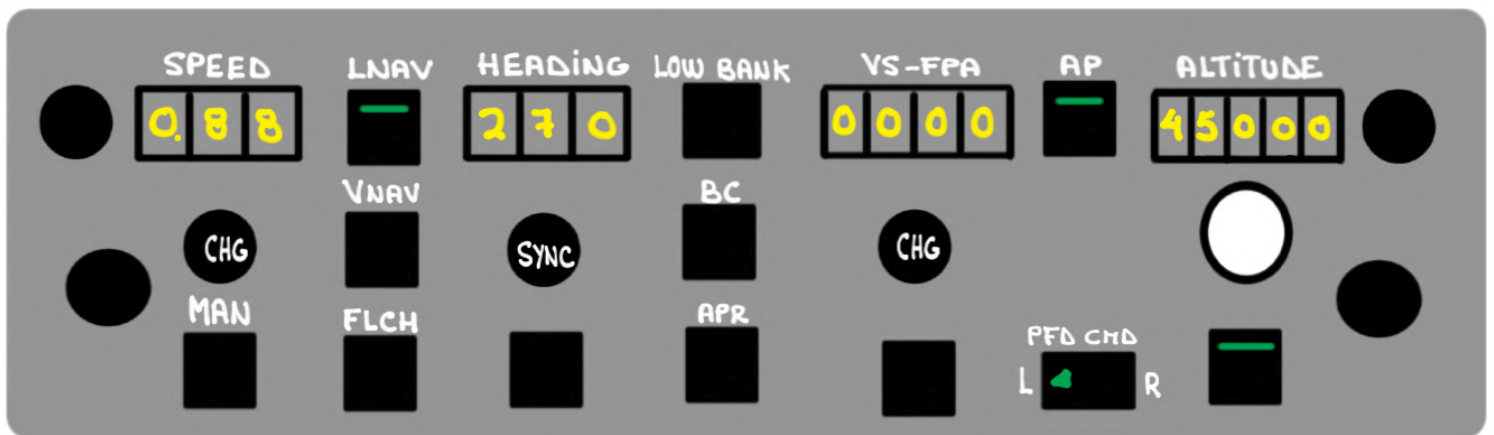
6) COORDINATION WITH PRECEDING AIRCRAFT, if REQUIRED,
ON 123.45 MHz

7) A WAKE TURBULENCE ENCOUNTER MUST BE REPORTED

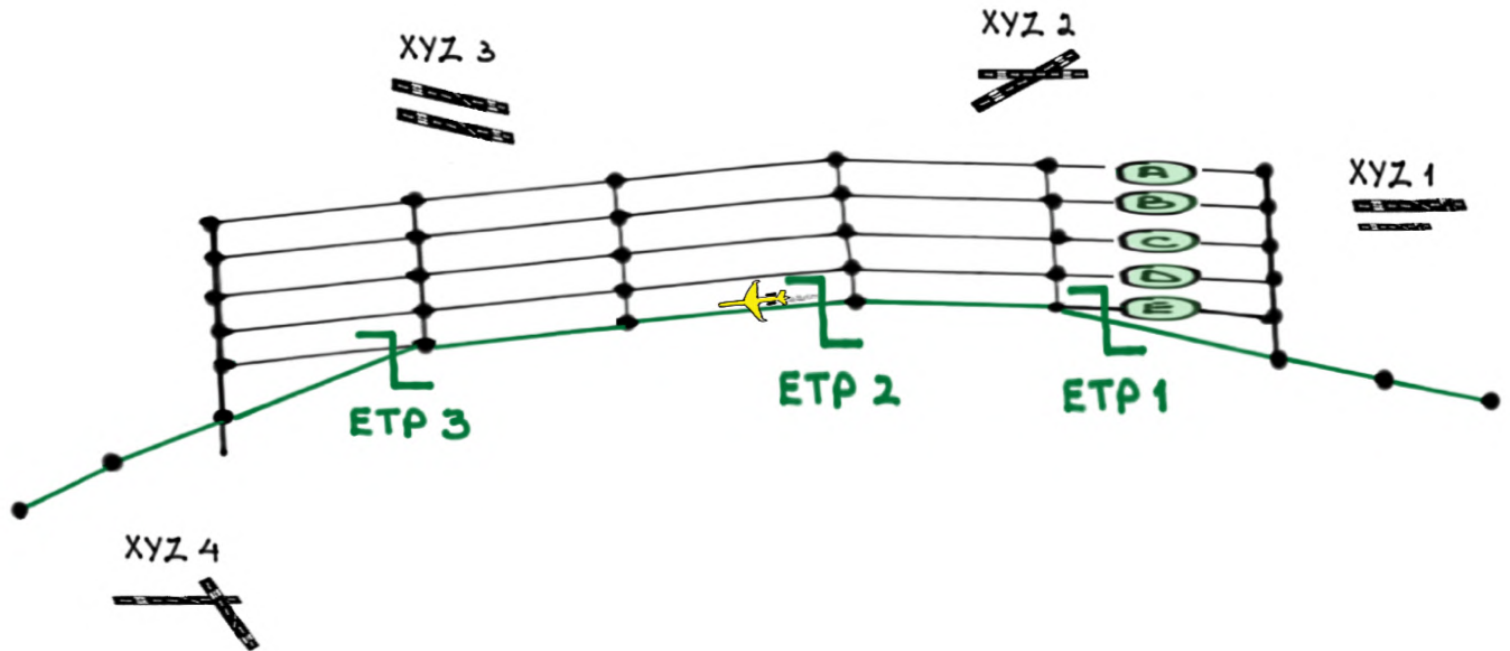


PART II

SCENARIO



- North ATLANTic / Random Route / WESTbound
- FL450, MO.88, 80,000 lbs / ISA + 5
- SLOP R2, left engine flames out AFTER ETP 2

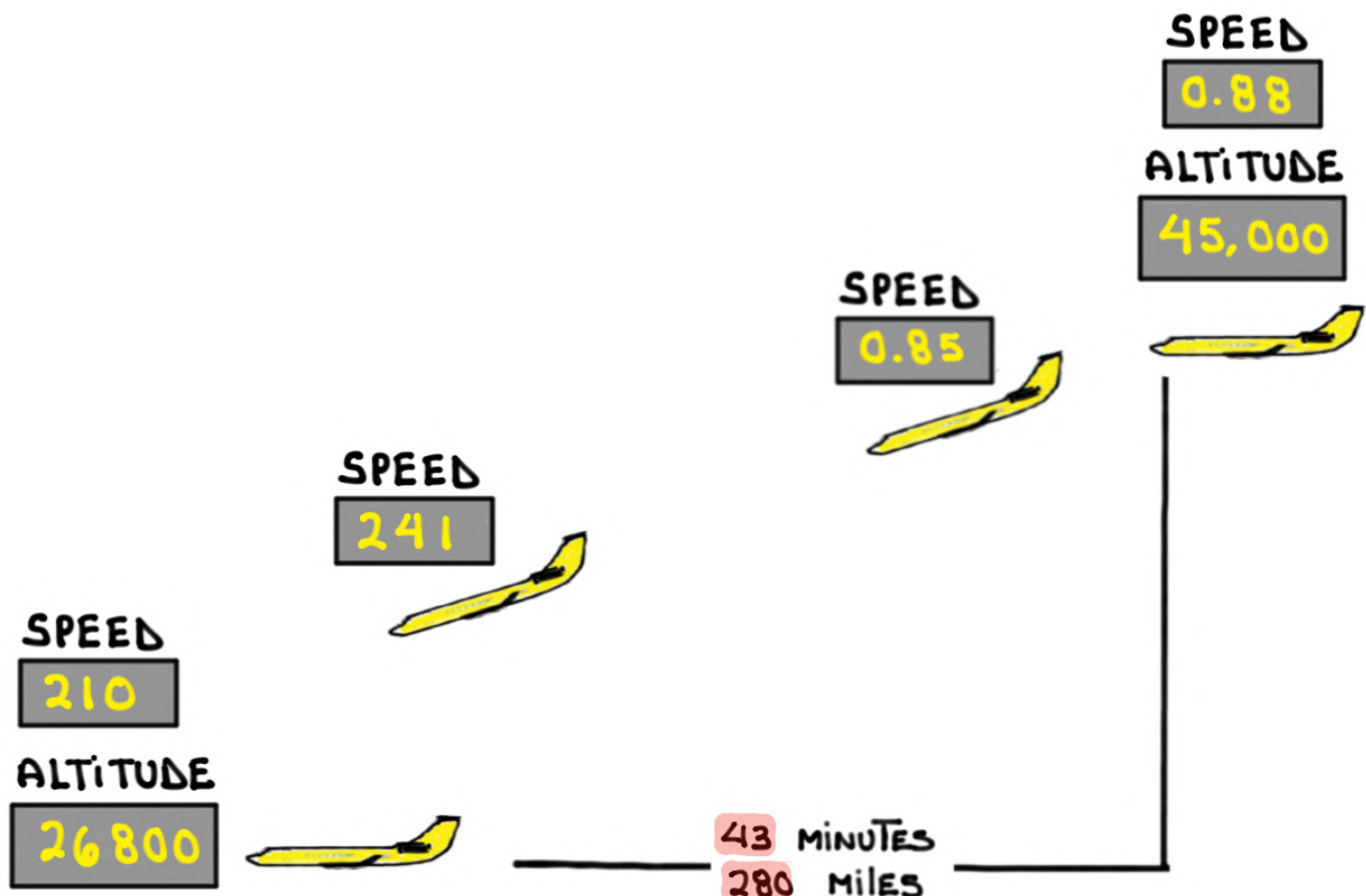


SCENARIO'S OBJECTIVE:

- ① REVIEW RELEVANT DRIFTDOWN PROCEDURES
- ② AVIATE, NAVIGATE, AND COMMUNICATE
- ③ ASSESS how an ENGINE FAILURE AFFECTS OTHER SYSTEMS

PART III

Driftdown PROCEDURES



S. E. RANGE

The G650's MCDU calculates and displays the following single engine range information:

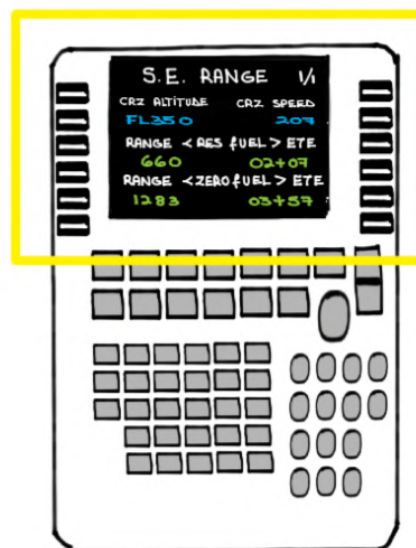
- RANGE AND TIME TO FUEL RESERVES
- RANGE AND TIME TO ZERO FUEL

Calculated at the optimum LRC altitude and speed when operating with one engine inoperative (OEI)

1) **PERF**

2) LSK 5R - S.E. RANGE

```
S. E. RANGE 1/1
CRZ ALTITUDE  CRZ SPEED
FL350         207
RANGE < RES FUEL > ETE
660          02+07
RANGE < ZERO FUEL > ETE
1283         03+57
```



ENGINE OUT DrifTdown

DrifTdown Procedure:

TO ATTAIN THE drifTdown PERFORMANCE SHOWN, THE RECOMMENDED drifTdown PROCEDURE DESCRIBED BELOW MUST BE FOLLOWED:

- (A) AT THE FAILURE OF ONE ENGINE, MAXIMUM CONTINUOUS THRUST IS SET AND HELD ON THE OPERATING ENGINE DURING ANY DECELERATION IF REQUIRED TO REDUCE THE SPEED TO THE ENTRY DESCENT MACH. ANY DECELERATION SHOULD BE PERFORMED AT THE INITIAL CRUISE ALTITUDE BEFORE THE START OF DESCENT
- (B) THE DESCENT MACH NUMBER SHOULD BE MAINTAINED UNTIL THE CALIBRATED SPEED IS INTERCEPTED. THE CALIBRATED SPEED IS THEN HELD DOWN TO THE FINAL drifTdown ALTITUDE (IDENTIFIED AS CRUISE ALTITUDE)

ENGINE OUT DRIFTDOWN

ISA +5

Initial ALT (FT) OAT (°C)		Initial Driftdown Weight - 1000 LB			
				80	
45,000	DSCNT MACH/KCAS TIME FUEL DIST START CRUISE CRUISE ALTITUDE			0.85/241 43 1949 280 210 26800	
-51.5					

- (c) AT THE final driftdown ALTITUDE, A 200 FPM RATE OF climb capability will be possible AT MCT AT THE "START CRUISE" calibrated AIRSPEED shown (LRC speed)
- (d) MODERATE THRUST REDUCTIONS ARE REQUIRED AT THE "CRUISE ALTITUDE" TO STABILIZE AT THE "START CRUISE" calibrated AIRSPEED

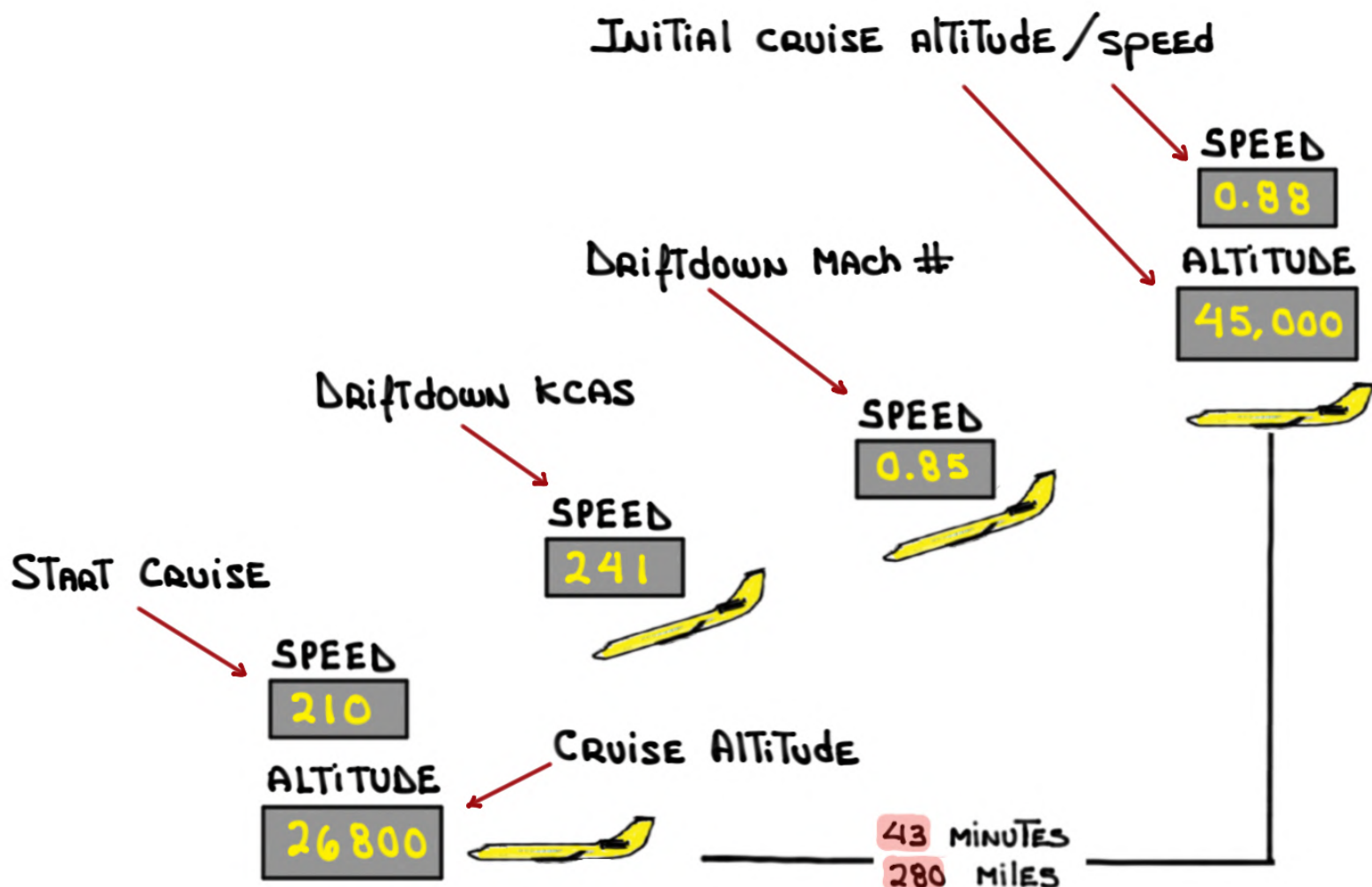
Driftdown Profile

Engine Out Driftdown ISA +5

Initial Alt (FT)		Initial Driftdown Weight - 1000 LB	
Initial Alt (FT)	ORT (°C)		
			80
45,000	-51.5		0.85/241 43 1949 280 210 26800

0.85/241
43
1949
280
210
26800

0.85/241
43
1949
280
210
26800



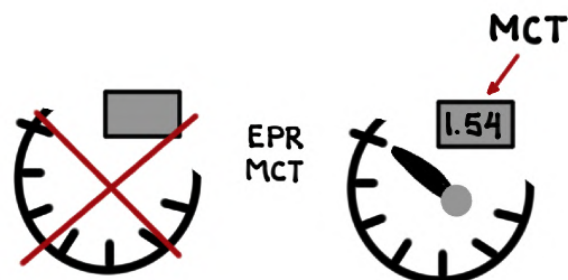
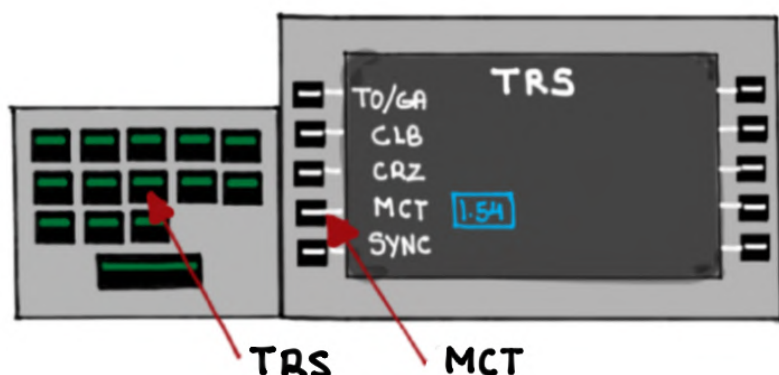
① Fly The AIRCRAFT:



L ENGINE FAIL

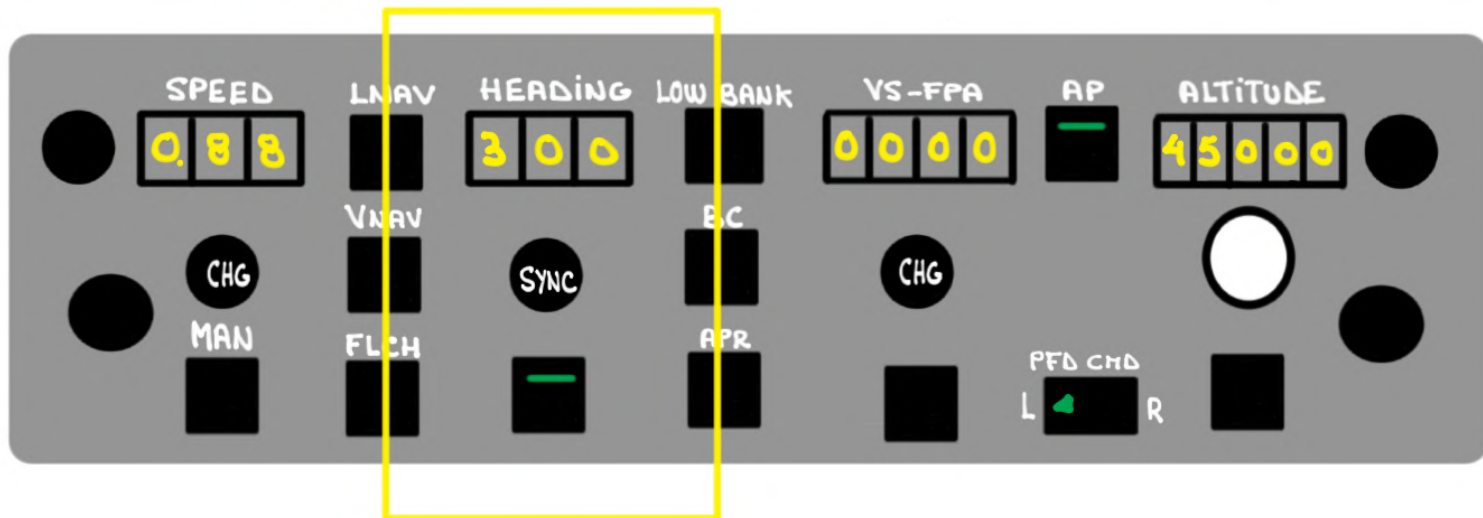


- The AUTOPILOT will REMAIN ENGAGED
- The AUTOTHROTTLE will DISCONNECT AUTOMATICALLY
- THERE will be SOME yaw AS THE LEFT ENGINE ROLLS back
- REGAIN AND MAINTAIN DIRECTIONAL CONTROL
- SET MAXIMUM CONTINUOUS THRUST (MCT) ON OPERATING ENGINE

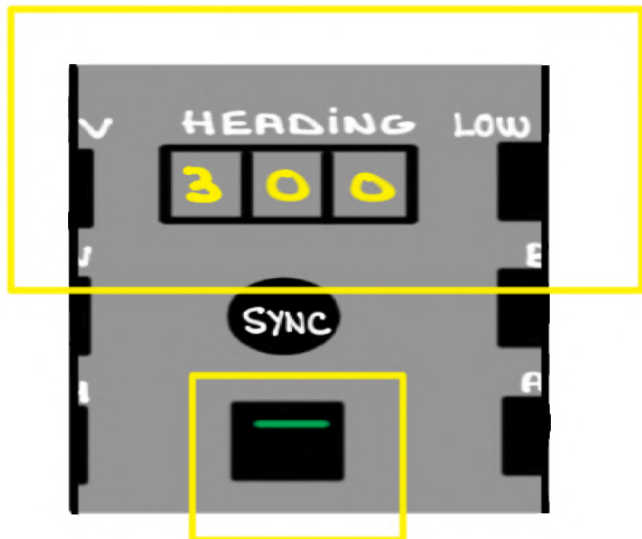


② TURN AWAY FROM THE TRACK:

- Sync HDG, SELECT HDG, AND ROTATE HDG knob $\geq 30^\circ$ To The Right (direction To XYZ3)



XYZ 3



③ CREATE R5.0 offset:

1) **PROG**

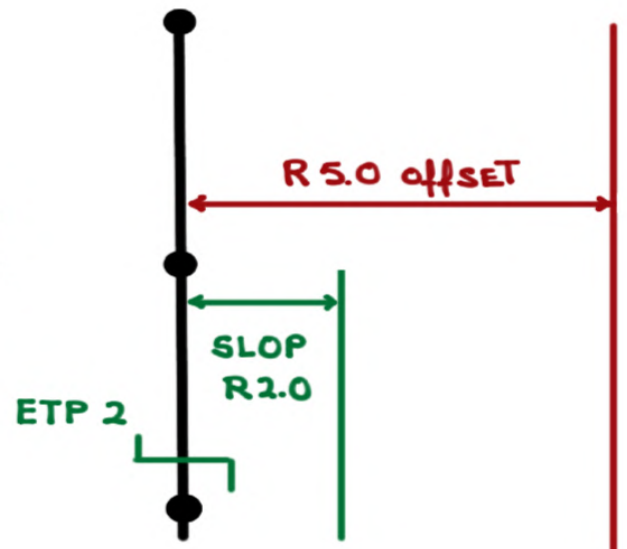
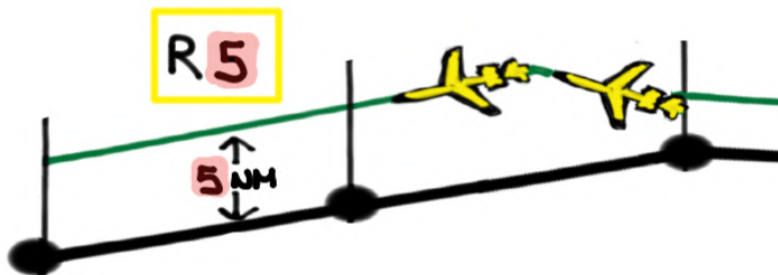
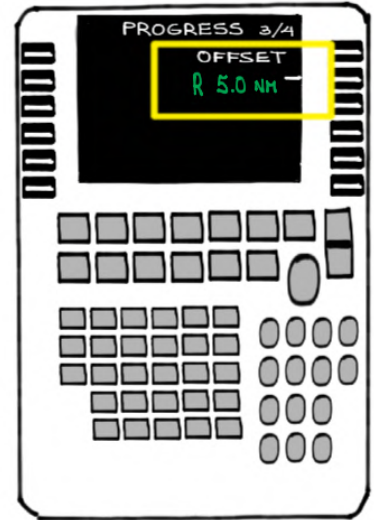
2) **NEXT NEXT**

3) SCRATCH PAD: **R5**

4) **—** LSK 1R

5) SELECT **—** LNAV ON GUIDANCE PANEL

6) CONFIRM **FMS** is CAPTURED/ANNUNCIATED



④ Call for DriftDown Chart

AFM

OPERATING
MANUAL

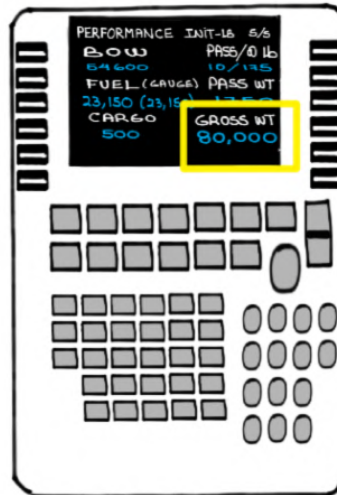
PERFORMANCE

ENGINE OUT DriftDown Charts

1) **PERF**

2) **—** LSK 1L

3) **PREV**



PERFORMANCE INIT-18 5/5
BOW 54600 PASS/O 10/135
FUEL (GAUGE) 23,150 (23,150) PASS WT 1750
CARGO 500 GROSS WT 80,000



DESCNT MACH/KCAS
TIME
FUEL
DIST
START CRUISE
CRUISE ALTITUDE

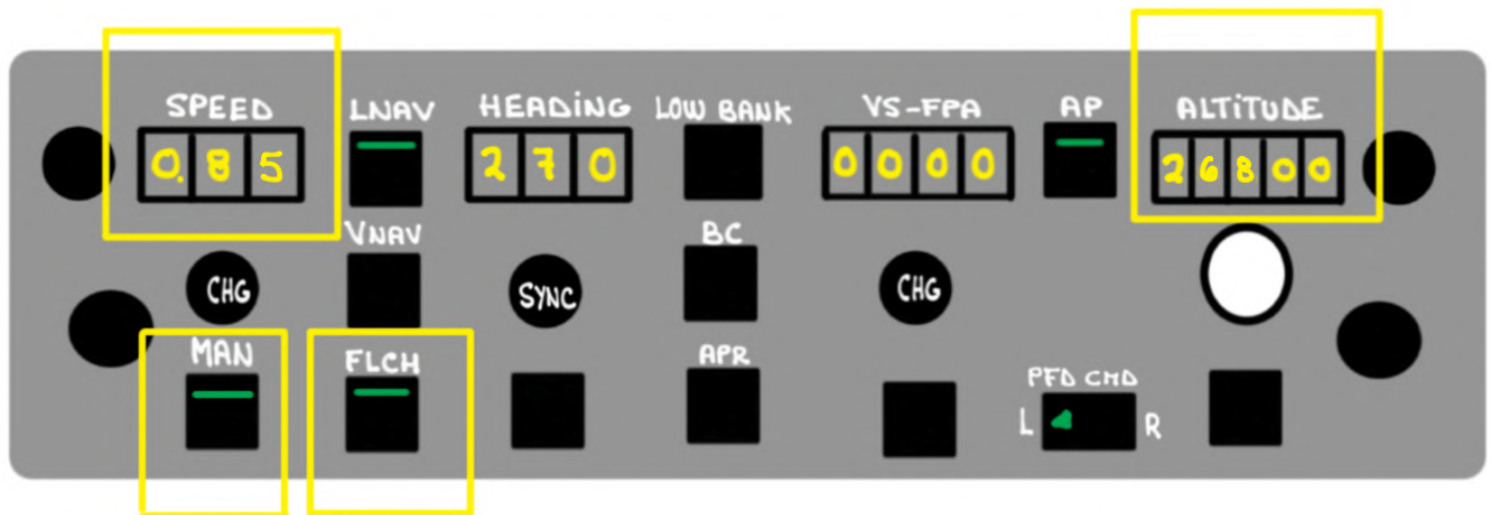
Engine OUT DriftDown

ISA +5

Initial ALT (FT) OAT (°C)		Initial DriftDown Weight - 1000 LB	
			80
45,000	DESCNT MACH/KCAS TIME Fuel Dist START CRUISE CRUISE ALT		0.85/241 43 1949 280 210 26800
-51.5			

⑤ DESCEND below The OTS (<FL290):

- SET Single ENGINE CRUISE ALTITUDE
- SELECT  AND SET DESCENT MACH NUMBER
- SELECT 

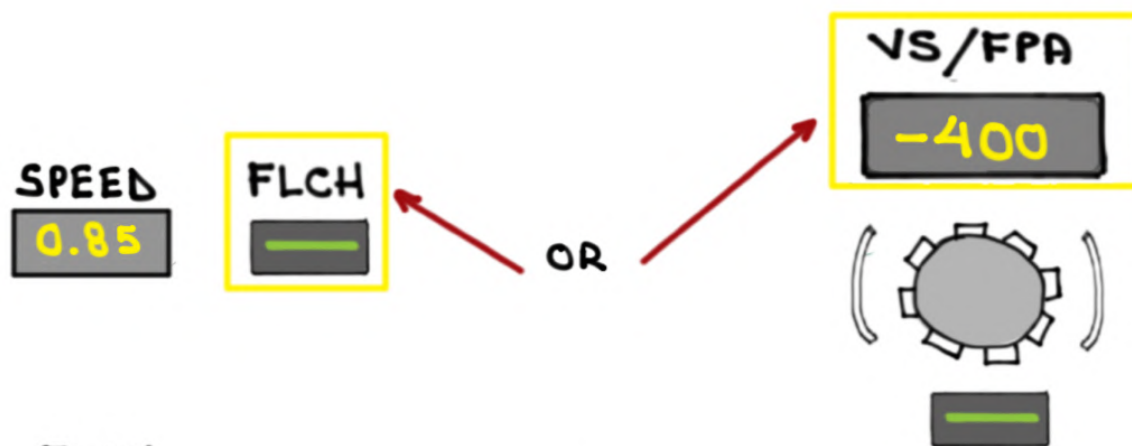




NOTES:

- DECELERATION from M0.88 To M0.85 should be AT The initial CRUISE ALTITUDE of 45,000'
- EXPECT deceleration RATE To INCREASE while TURNING away from The TRACK

- Do NOT allow speed to decrease below M0.85
- In order to maintain M0.85 the descent will likely commence before being established on a same direction 5 NM lateral offset
- AutoTrottle MUST REMAIN OFF To maintain the driftdown profile
- Speed control mode:

The AFM, AOM and QRH do NOT provide guidance as to which vertical mode to use

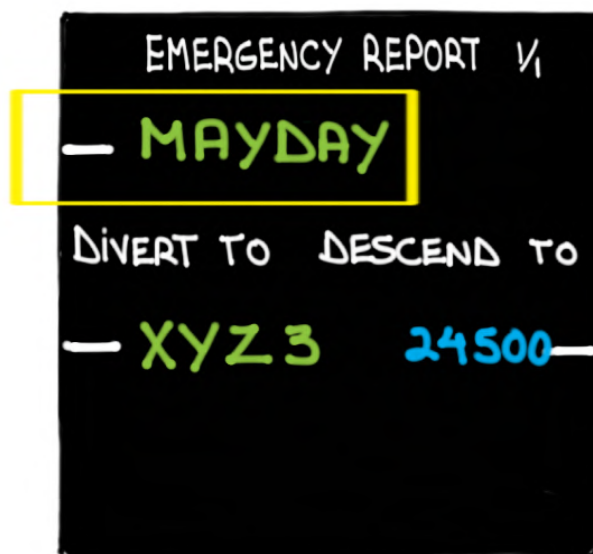
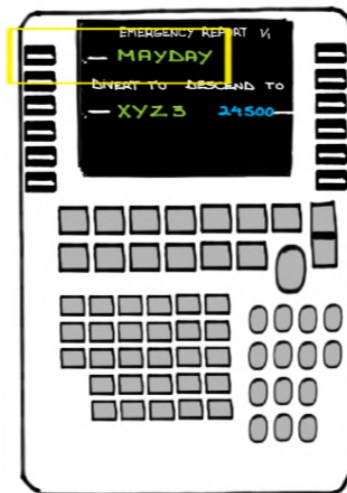


If  RESULTS in speed oscillations during the driftdown, as the AFCS corrects for speed deviations, consider using  instead

⑥ COMMUNICATE - ATC:

DATALink (CPDLC/ADS-C)

- 1) **NAV**
- 2) **—** LSK 1R - ATC
- 3) ATC Logon/STATUS 1/2
- 4) **—** LSK 6L - ATC INDEX
- 5) **—** LSK 1L - **EMERGENCY**
- 6) **—** LSK 1L - **MAYDAY**
- 7) POPULATE EMERGENCY REPORT
- 8) VERIFY IT AND SEND IT



⑦ OTHER TRAFFIC:

- 1) BROADCAST your situation, position AND intentions ON 121.5 AND 123.45 MHz
- 2) TURN ON ALL EXTERNAL lights *
 - * Landing lights do NOT function ABOVE 18,000'
 - * Pulse lights function without altitude RESTRICTIONS
- 3) MONITOR TCAS
- 4) LOOK FOR CONTRAILS/TRAFFIC

⑧ SECURE failed ENGINE:

- AFM → EMERGENCY

- OR QUICK REFERENCE PROCEDURES

- ENGINE SHUTDOWN
IN FLIGHT

⑨ START THE APU:

- AFM → NORMAL

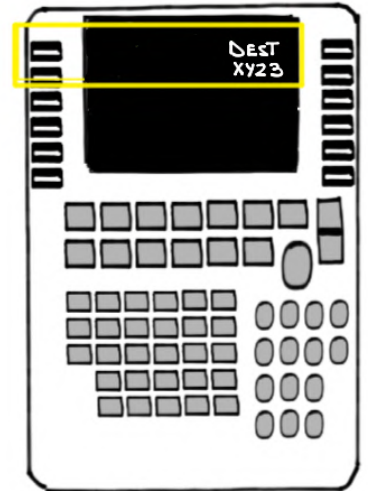
- CHAPTER 02 - NORMAL

- ALTERNATE NORMAL


- APU IN FLIGHT
OPERATION

⑩ CHANGE DESTINATION AIRPORT:

- 1) **FPL**
- 2) **PREV**
- 3) SCRATCH PAD : XYZ3
- 4) **—** LSK (DEST)
- 5) **—** LSK 6R - ACTIVATE



⑪ PROCEED TO ALTERNATE AIRPORT:

- ONCE SAFELY BELOW THE OTS (<FL **290**) **LNAV**
PROCEED ➡ TO THE ETP AIRPORT 
- UPDATE flight plan winds
- If you HAVEN'T RECEIVED A REVISED ATC CLEARANCE CONTACT ATC AND REQUEST ONE
- SQUAWK TRANSPONDER CODE **7700**
- SET ADS-C TO **EMERGENCY**

⑫ Flight CREW To CABIN CREW: TEST

T = Type of **EMERGENCY**

E = Exit/evacuation plan

S = Signals "Two minutes, two minutes"
"Ten seconds"
"EZ Victor"

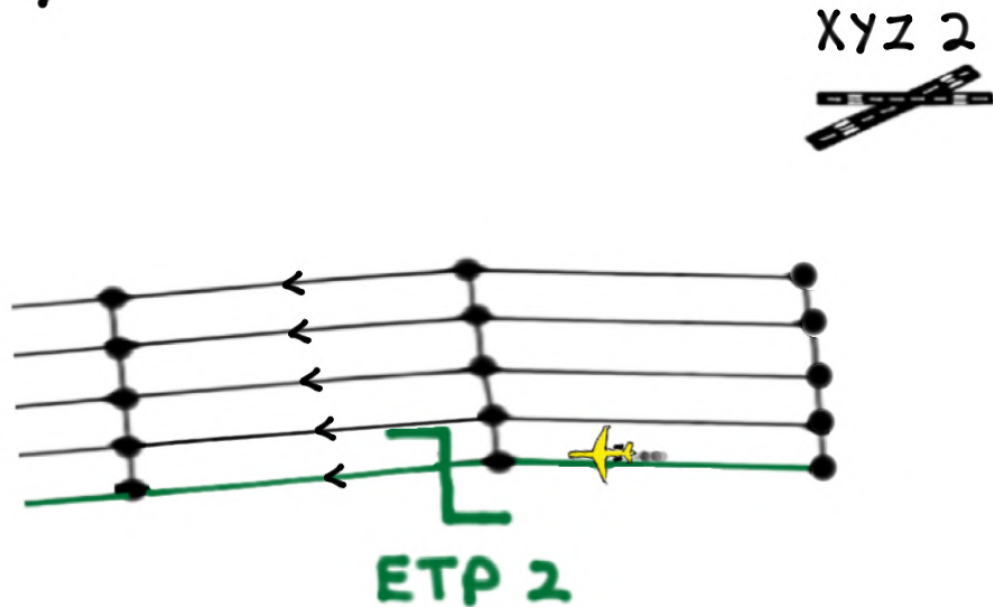
T = Time to prepare

⑬ Flight Dispatch/Maintenance Dpts:

- Notify your dispatch team about your situation, intentions, and requirements
- The above can be done through your Communications Service Provider (CSP)

What if?

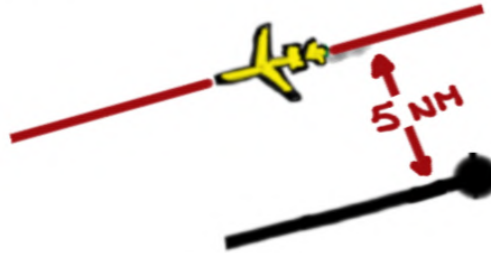
If The ENGINE had failed PRIOR To CROSSING
ETP 2 A DIVERSION To XYZ 2 WOULD HAVE BEEN
NECESSARY



ONCE ESTABLISHED ON A SAME DIRECTION **5** NM LATERAL
OFFSET AN EXPEDITED DESCENT THROUGH FL **290** (THE
BOTTOM OF THE OTS TRACKS) WOULD HAVE BEEN
REQUIRED BEFORE INITIATING A TURN-BACK DIVERSION
ACROSS THE FLOW OF ADJACENT TRAFFIC ABOVE

1ST

5 NM SAME DIRECTION offset



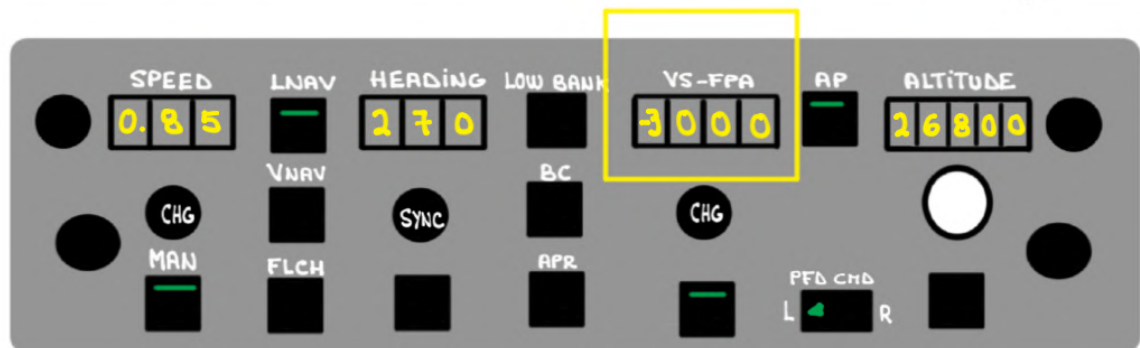
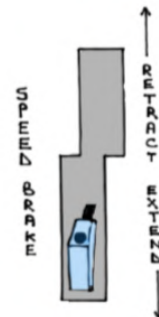
2ND

Expedited descent below OTS

FL420	
FL410	
FL400	
FL390	
FL380	
FL370	
FL360	
FL350	
FL340	
FL330	
FL320	
FL310	
FL300	
FL290	



SPEED BRAKE EXTENDED



3RD

XYZ 2



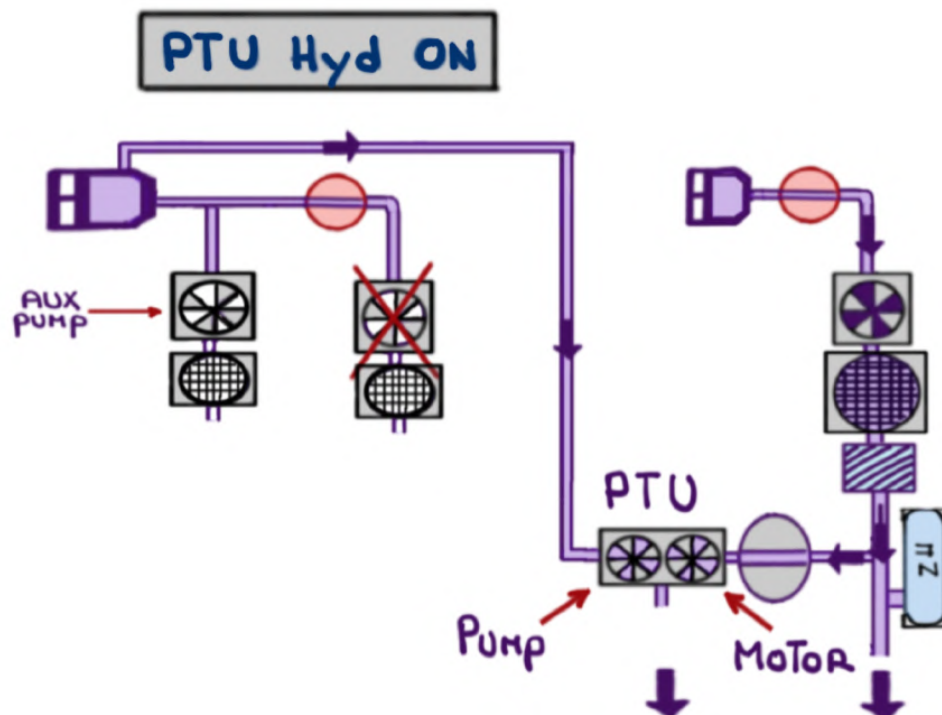
DIR

SPEED
210

ALTITUDE
26500

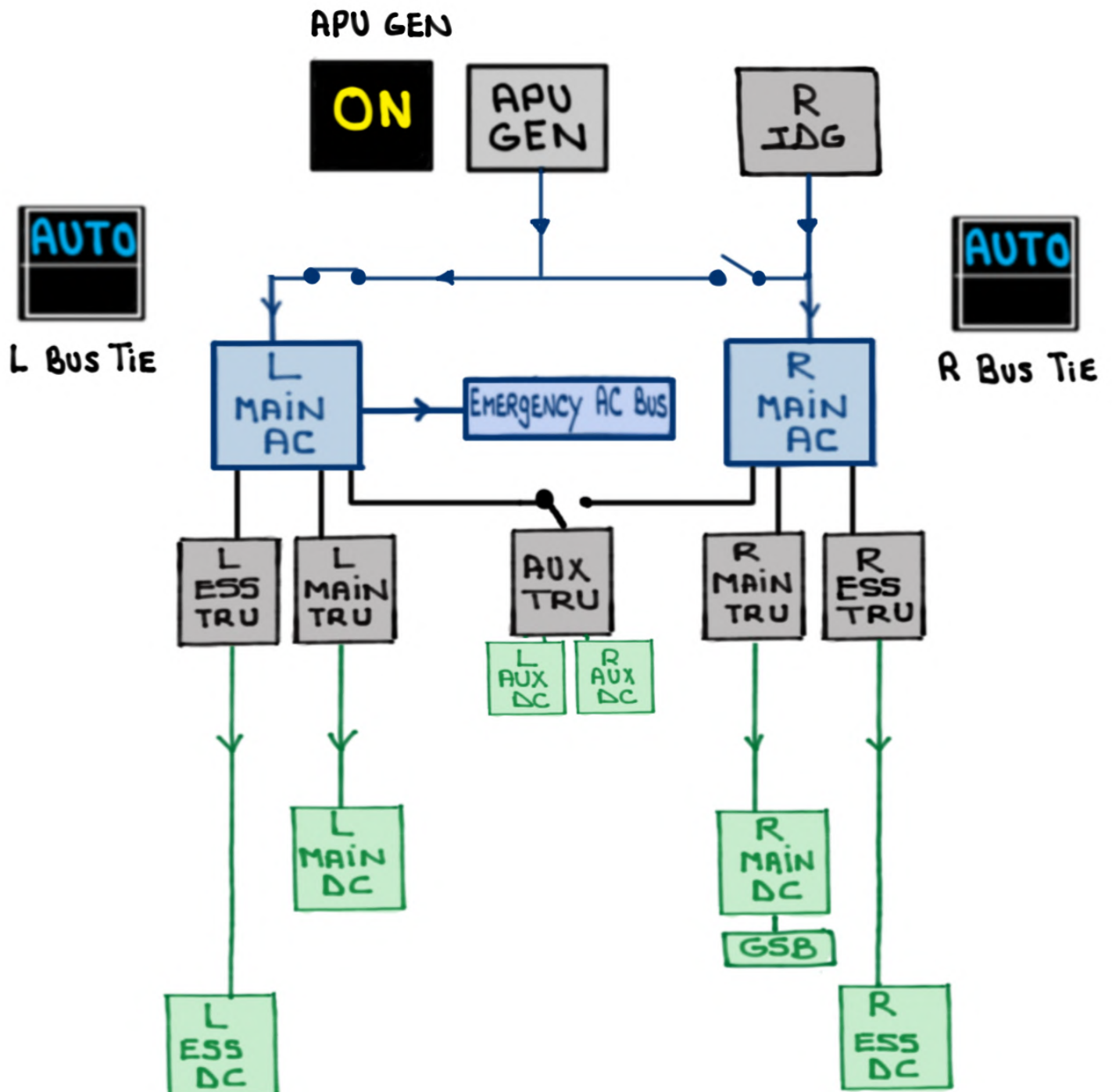
PART IV

Systems' ASSESSMENT



ELECTRICAL SYSTEM

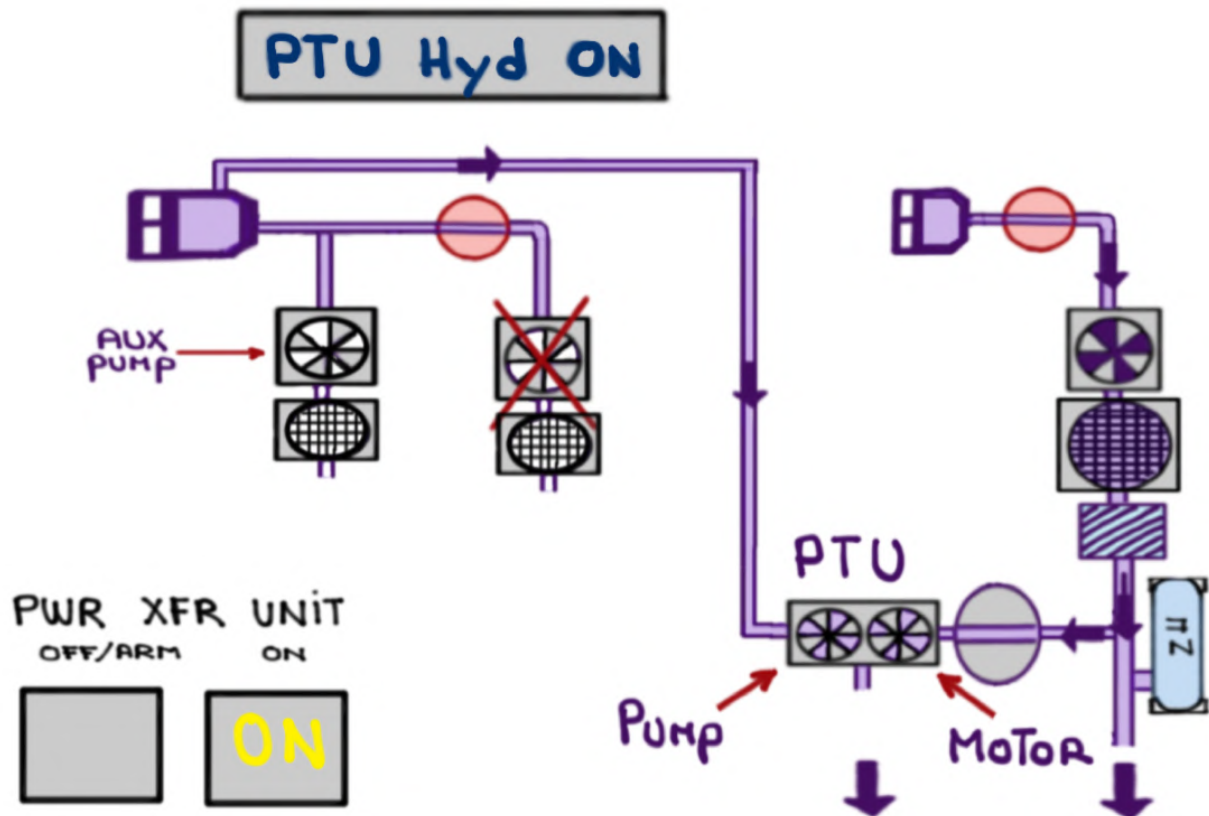
APU GEN And R IDG power all AC And DC buses



Hydraulic System

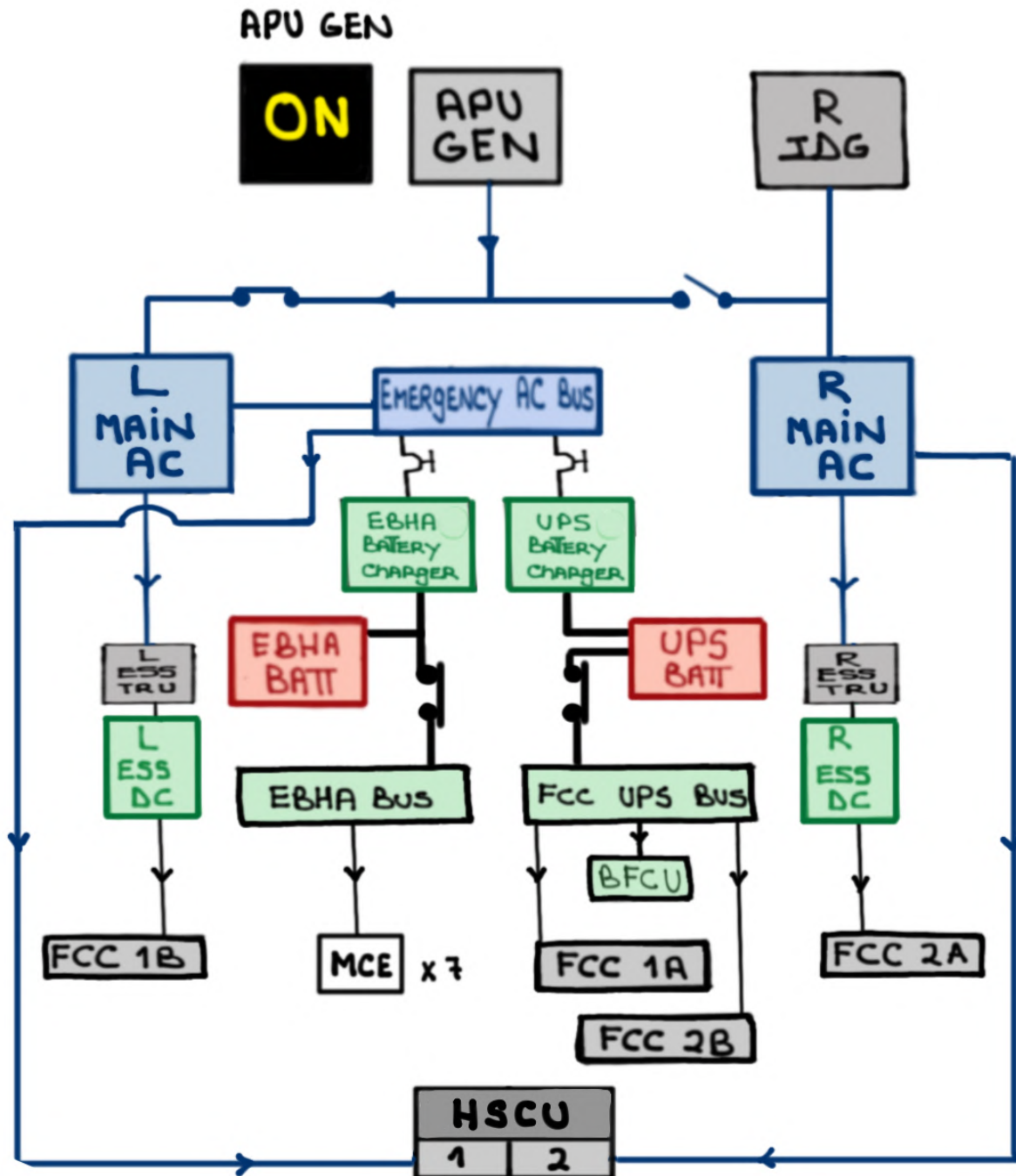
The Power Transfer Unit (PTU) will take over the duties of the inoperative EDP as soon as L Hyd System pressure drops below **2,400** Psi

- Loss of left Thrust Reverser
- Loss of midboard spoiler panels



Flight Control System

NORMAL LAW Mode



FUEL SYSTEM

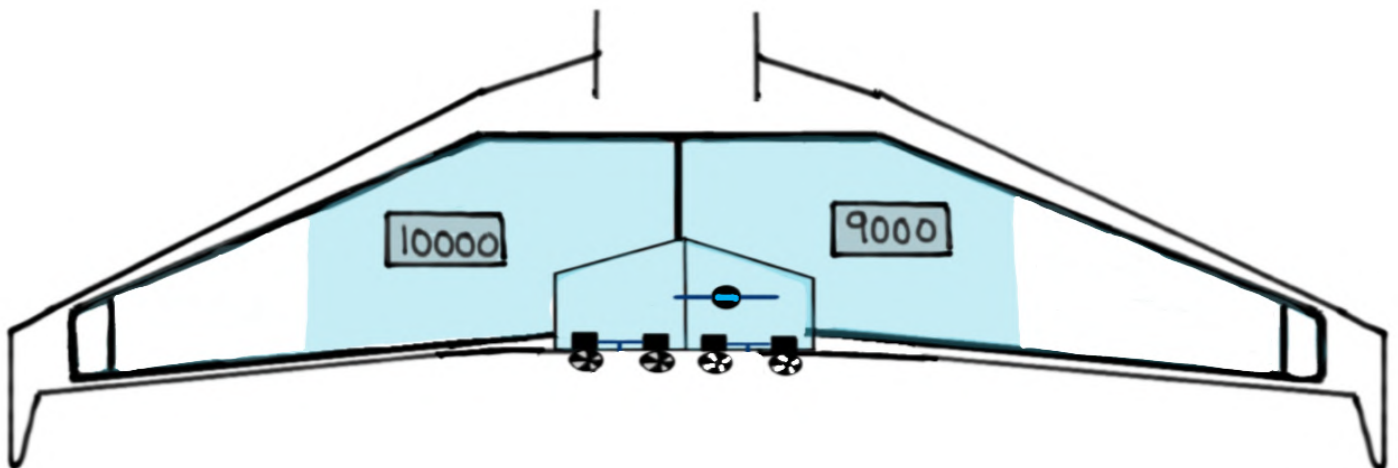
All FUEL SYSTEM COMPONENTS OPERATE NORMALLY

A fuel imbalance condition will develop

- AFM → **NORMAL**
- CHAPTER 02 - NORMAL
- ALTERNATE NORMAL
- FUEL BALANCING in flight

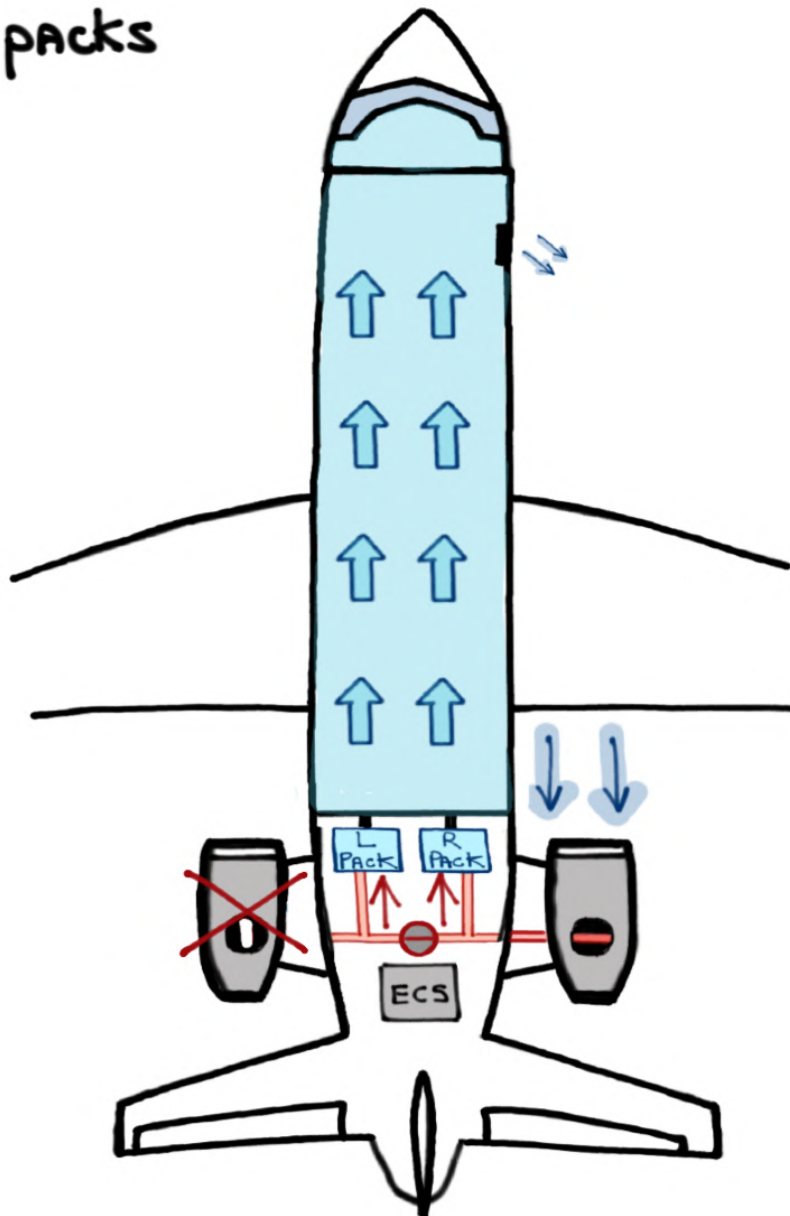
FUEL IMBALANCE

10000 **L** 9000



PNEUMATIC SYSTEM

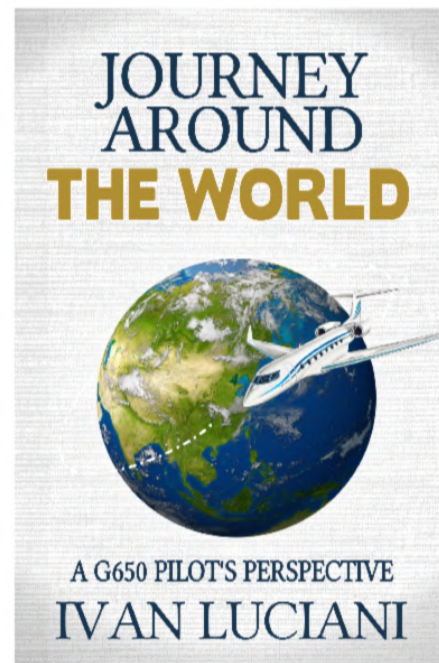
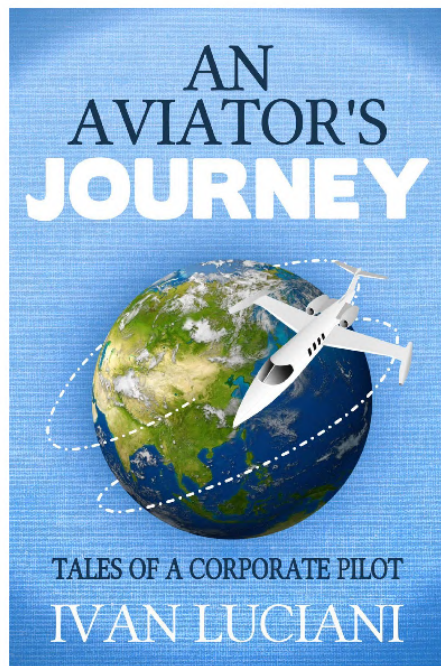
REMAINING ENGINE CAN PROVIDE THE NECESSARY BLEED AIR (**High PRESSURE AND TEMPERATURE**) VIA ITS ONSIDE MANIFOLD. OPENING THE ISOLATION VALVE ALLOWS THE OPERATING ENGINE TO PROVIDE BLEED AIR TO THE OPPOSITE SIDE'S ECS PACKS



REMINDER: these system notes are intended for study purposes only. Always refer to official Gulfstream manuals and other approved references when operating your aircraft.

NOTE: these system notes are updated from time to time and what is posted on Code450.com will always be the most recent version.

Questions, comments or errors...please do send me an email:
ivan@code7700.com



Thank you!