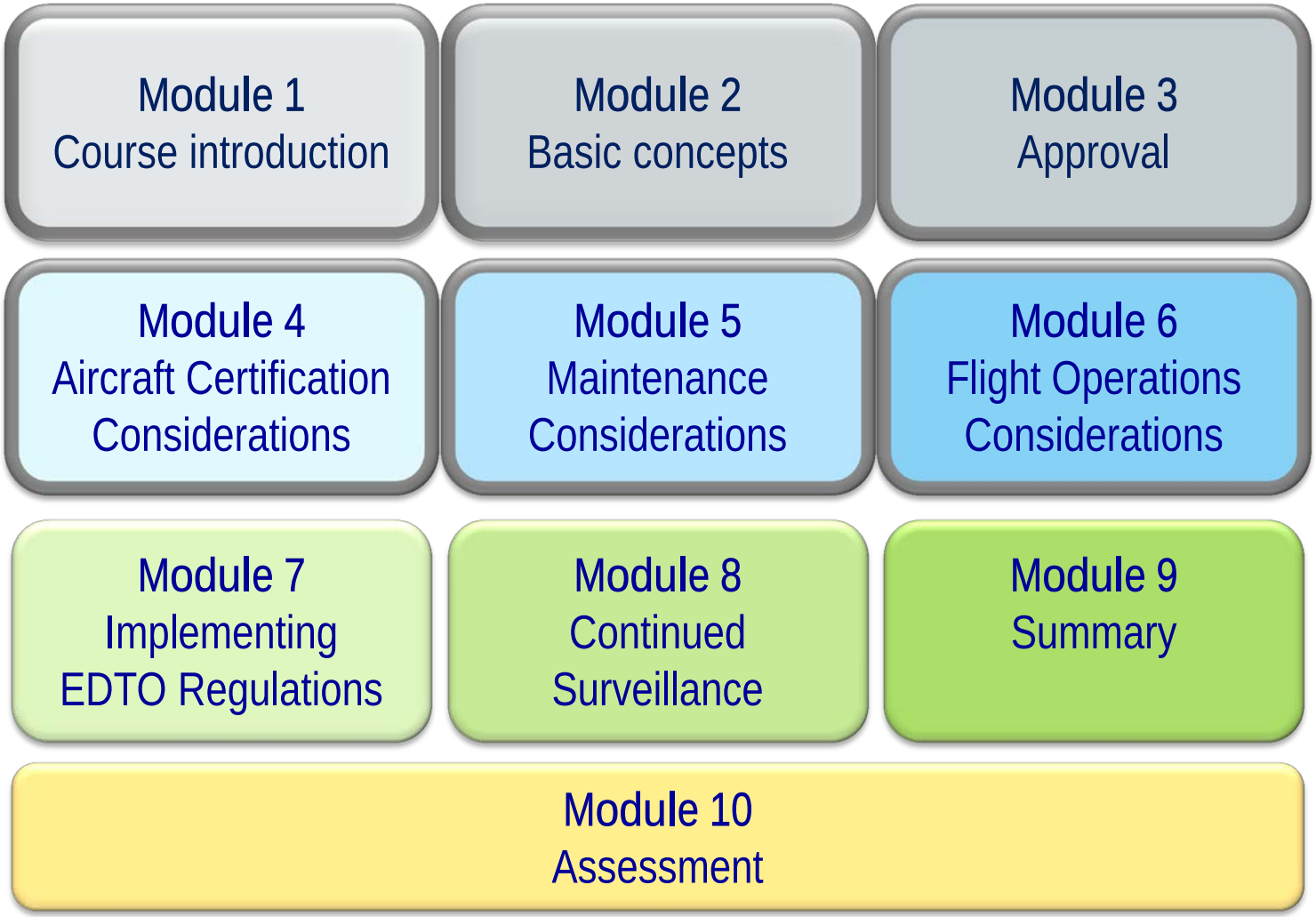
EDTO Workshop

Module N° 6 – Flight Operations considerations

Course Structure

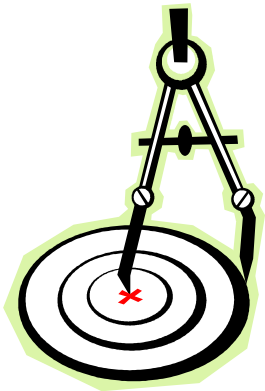


Objectives

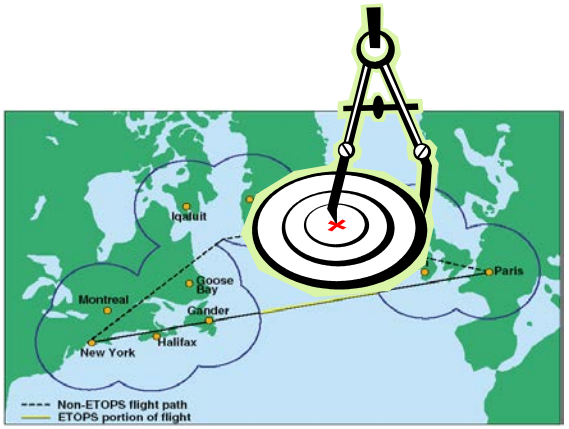
- *At the end of this module, participants will understand the flight operations requirements supporting EDTO operations.*

Outline

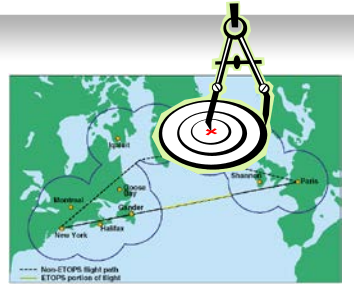
- EDTO Flight Operations Program Overview
- Airplane performance considerations
- Approval route planning / EDTO area of operations
- Dispatch planning
- Enroute considerations
- Procedures documentation and training



EDTO Flight Operations Program Overview



EDTO Flight Operations Program
Continued



Overview

1) Define EDTO routes that will be covered by application.
2) For each route, establish a list of Adequate En-route Alternate Airports.
3) Determine EDTO diversion time required and EDTO engine inoperative planning speed.
4) Establish EDTO Area of Operations.

Approval Route Planning

5) Establish a system for obtaining EDTO flight plan data.
   - EDTO en-route alternates, Equal Time Points, Critical Fuel Scenario, Time Limited Systems.
6) Arrange to obtain weather data for EDTO en-route alternates.
7) Ensure there is a method of communication between the airplane and the airline during the flight (flight following).

Dispatch Planning

EDTO Flight Operations Program
Continued

Overview (cont'd)

8) Review EDTO provisions in the FAA approved MMEL to establish the airline's MEL.

9) Establish a method to check APU in-flight start reliability.

10) Designate an EDTO Check Airman.

11) Establish and document airline operating procedures for EDTO.

    Note: If the airline plans to change Boeing FCOM procedures, determine if changes need to be re-validated

12) Revise the airlines flight crew guidance material to include EDTO practices and procedures.

13) Train flight dispatchers and flight crew on EDTO requirements, performance data, MEL and airline unique EDTO processes.

EDTO Flight Operations Program*
Continued

Section 303 and 304 of FAA AC 120-42B

Section 303, EDTO Flight Operations Guidelines

- Airplane Performance Data
- Airport Information
- Dispatch
- En-route
- EDTO Procedures Documentation

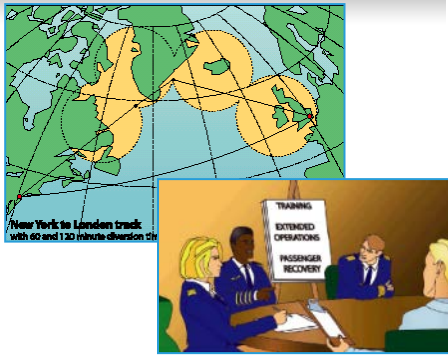
Section 304, Flight Operations Training Guidelines

- EDTO Unique Requirements
- Check Airmen used in EDTO
- Review of Training Program and Operating Manuals

* New advisory materials are consistent with current EDTO practices

EDTO Flight Operations Program*
Continued

EASA AMC 20-6, Revision 2



- Chapter III - Operational Approval Considerations
  - Section 8: EDTO Operations Manual Supplement
  - Section 9: Flight Preparation and In-Flight Procedures
  - Section 10: Operational Limitations
  - Section 11: EDTO Enroute Alternate Aerodromes
  - Section 12: Initial/Recurrent Training
- Appendix 3 - Operational Limitations
- Appendix 4 - Flight Preparation and Inflight Procedures
- Appendix 5 - EDTO Enroute Alternate Aerodromes
- Appendix 6 - EDTO Training Programme
- Appendix 7 - Typical EDTO Operations Manual Supplement

** New EASA guidance is largely harmonized with FAA rules*

Agenda

- Defining the EDTO area of operations
- Performing EDTO Flight Planning
- Conducting EDTO Flights
- Conclusions

Area of operations is EDTO required?

EDTO

Extended **D**iversion **T**ime **O**perations

Applies to operations conducted over a route that:

– In Still air and ISA conditions –

- contains a point **further than applicable threshold** (e.g. 60 min flying time for twins)
- at the **approved:**
  - **One Engine Inoperative (OEI) speed** *for* ***twins***
  - **All Engine Operative (AEO) speed** *for* ***airplanes with more than 2 engines***
- from an **adequate airport.**

Area of operations is EDTO required?

Adequate airport

Adequate Airport

To be qualified as adequate an airport must be :

- available,
- compatible with the performance requirements for the expected landing weight,
- have ground operational services such as ATS, lighting, communications, weather reporting,
- have at least one let-down navigation aid (ILS, VOR, NDB, Radar),
- have emergency services: Minimum Rescue and Fire Fighting Category: 4

Note : Other criteria should be taken into account (e.g. Hotel Capacity, Maintenance facilities,…)

Area of operations is EDTO required?
Continued

EDTO

Extended **D**iversion **T**ime **O**perations

Applies to operations conducted over a route that:

– In Still air and ISA conditions –

- contains a point **further than applicable threshold** (e.g. 60 min flying time for twins)
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- from an **adequate airport.**

Area of operations is EDTO required?

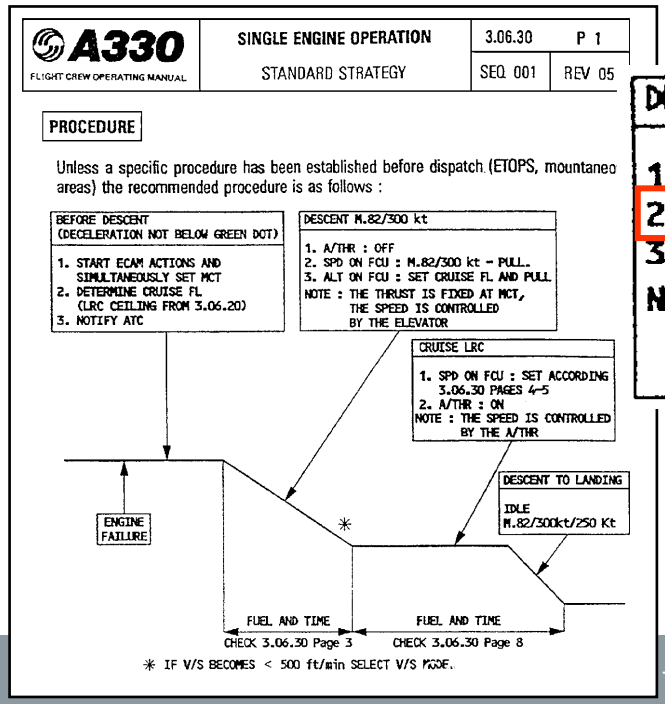
Diversion speed

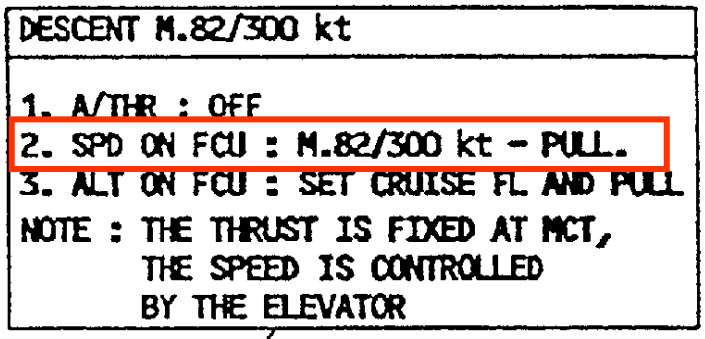
Diversion Speed

The approved one engine inoperative speed

- A diversion speed could be an IAS, TAS or even a MACH number.

- As TAS is not constant, the diversion speed is established at a given MACH/IAS combination, according to the aircraft capability:

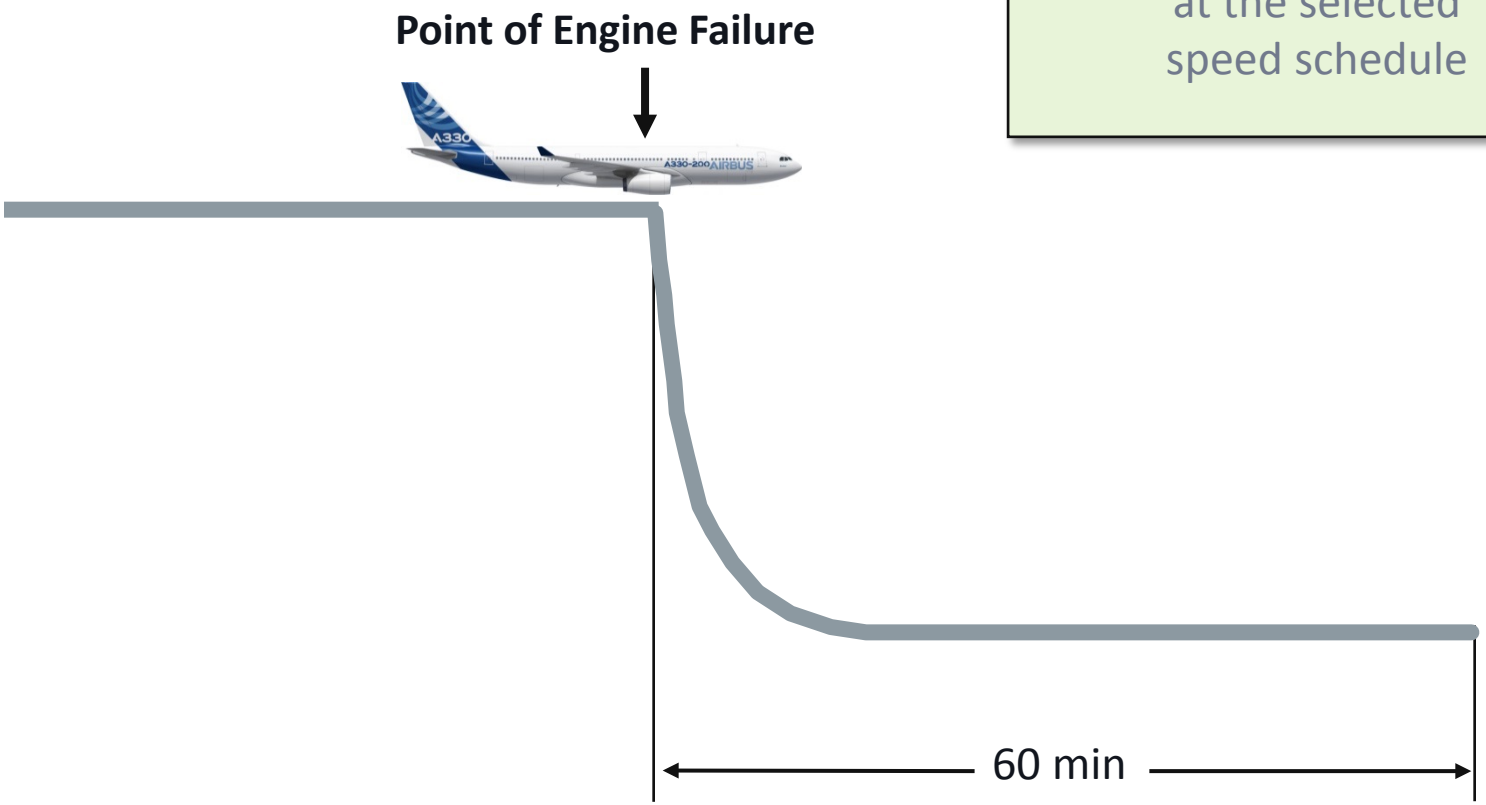




Area of operations is EDTO required?

Diversion speed (Cont)

Which speed to follow ?

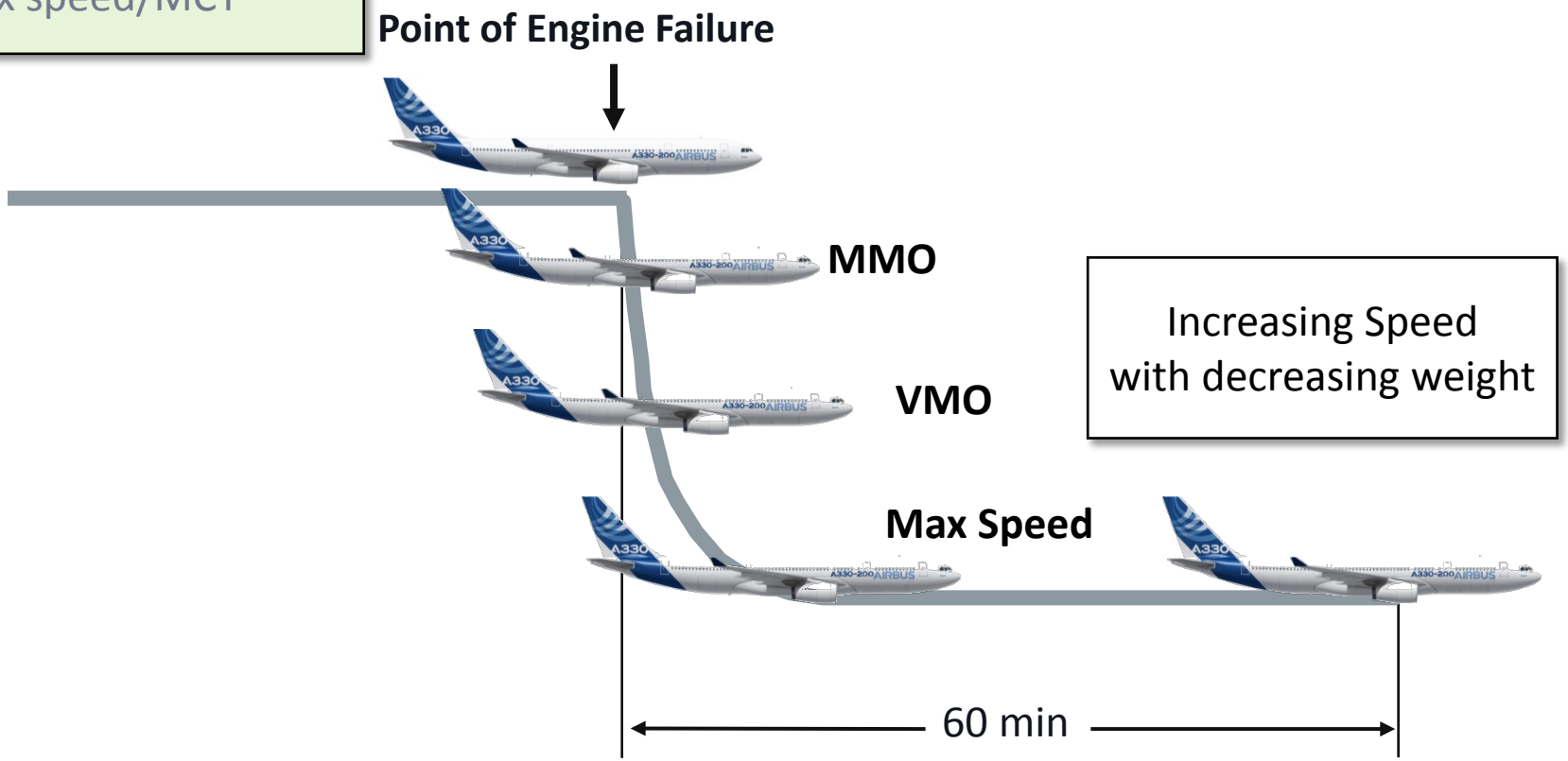


Descent + Cruise
at the selected
speed schedule

Area of operations is EDTO required?

Diversion speed (Cont)

Descent profile example:
Speed schedule
Max speed/MCT



Which speed to follow ?

Area of operations is EDTO required?

Diversion speed (Cont)

Diversion Speed

Choice of a Strategy

- The “Strategy” is defined in terms of a diversion speed
- The chosen speed (which will be approved) will have an impact on :
  - ✈ The diversion distance
  - ✈ The fuel consumption
  - ✈ The obstacle clearance

Diversion Speed

Choice of a Strategy

- The “Strategy” is defined in terms of a diversion speed
- The chosen speed (which will be approved) will have an impact on the diversion distance and the fuel consumption.

✈ Use Speed Schedule Max Speed / MCT

✈ Reduce if dictated by fuel considerations

Area of operations is EDTO required?
Continued

EDTO

Extended **D**iversion **T**ime **O**perations

Applies to operations conducted over a route that:

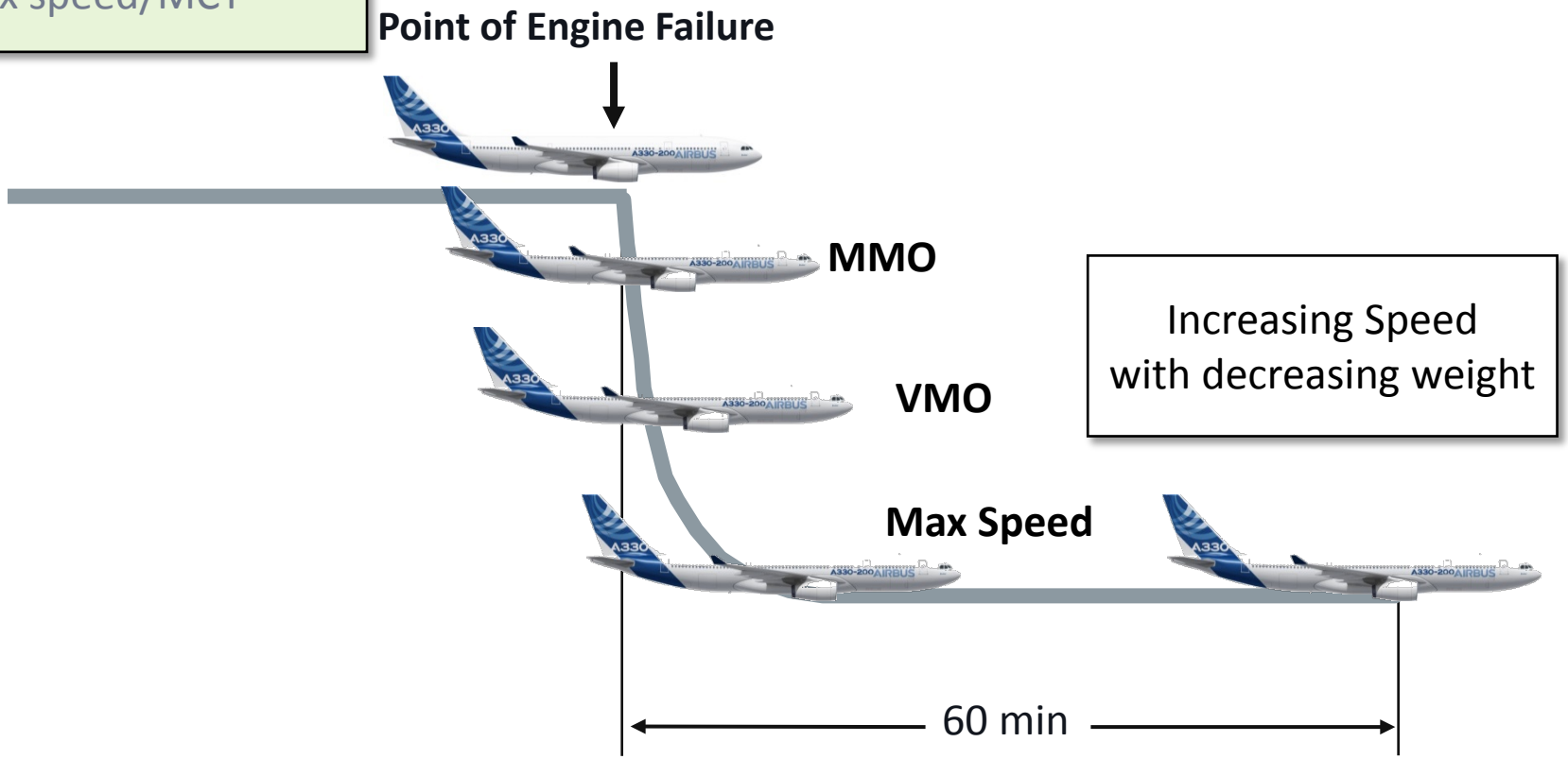
– In Still air and ISA conditions –

- contains a point **further than applicable threshold** (e.g. 60 min flying time for twins)
- at the **approved speed:**
  - **One Engine Inoperative (OEI) speed** *for* ***twins***
  - **All Engine Operative (AEO) speed** *for* ***airplanes with more than 2 engines***
- from an **adequate airport.**

Area of operations is EDTO required?

Diversion speed (Cont)

Descent profile example:
Speed schedule
Max speed/MCT



Increasing Speed
with decreasing weight

How do we account for aircraft weight and the diversion FL ?

Reference Gross Weight and Diversion FL

Choice of the parameters

- The heaviest of the **estimated gross-weights** at the **critical points** of the route or set of routes included in the area of operation.

- **Optimum diversion FL** with regards to the reference gross weight

Calculation requires some loops. A conservative way is to initialize with:

- *the TOW –1FH for 1 hour diversion distance, or*
- *The TOW –2FH for 2 hour diversion distance, or*
- *The TOW –3FH for 3 hour diversion distance, etc…*

Area of operations is EDTO required?

Reference gross weight (Cont)

A330 FLIGHT CREW OPERATING MANUAL	SPECIAL OPERATIONS EXTENDED RANGE OPERATIONS	2.04.40	P 11
		SEQ 060	REV 06

ISA

SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN) 60	90	120	150	180
MCT/330KT	150000	200	443	661	879	1097	1316
	160000	190	442	658	873	1089	1305
	170000	190	440	655	871	1087	1303
	180000	190	438	651	865	1080	1295
	190000	180	437	650	862	1075	1288
	200000	170	434	643	853	1063	1272
MCT/310 KT	150000	220	432	644	856	1069	1281
	160000	210	429	639	848	1058	1267
				639	848	1058	1267
				632	858	1044	1251
				631	838	1044	1251
	200000	190	421	624	828	1031	1234

Initialize with a high weight to be conservative.
Consider a reduction if necessary.

Area of operations is EDTO required?
Continued

Drawing the threshold circles:

1. Determine the “Adequate airports” over the intended route

2. Get the threshold distance (e.g. for 60 min) from relevant aircraft performance manual or tool.

3. Draw the circles centered on each “Adequate Airport”

4. If the route goes outside these circles, EDTO is required.

Area of operations – EDTO

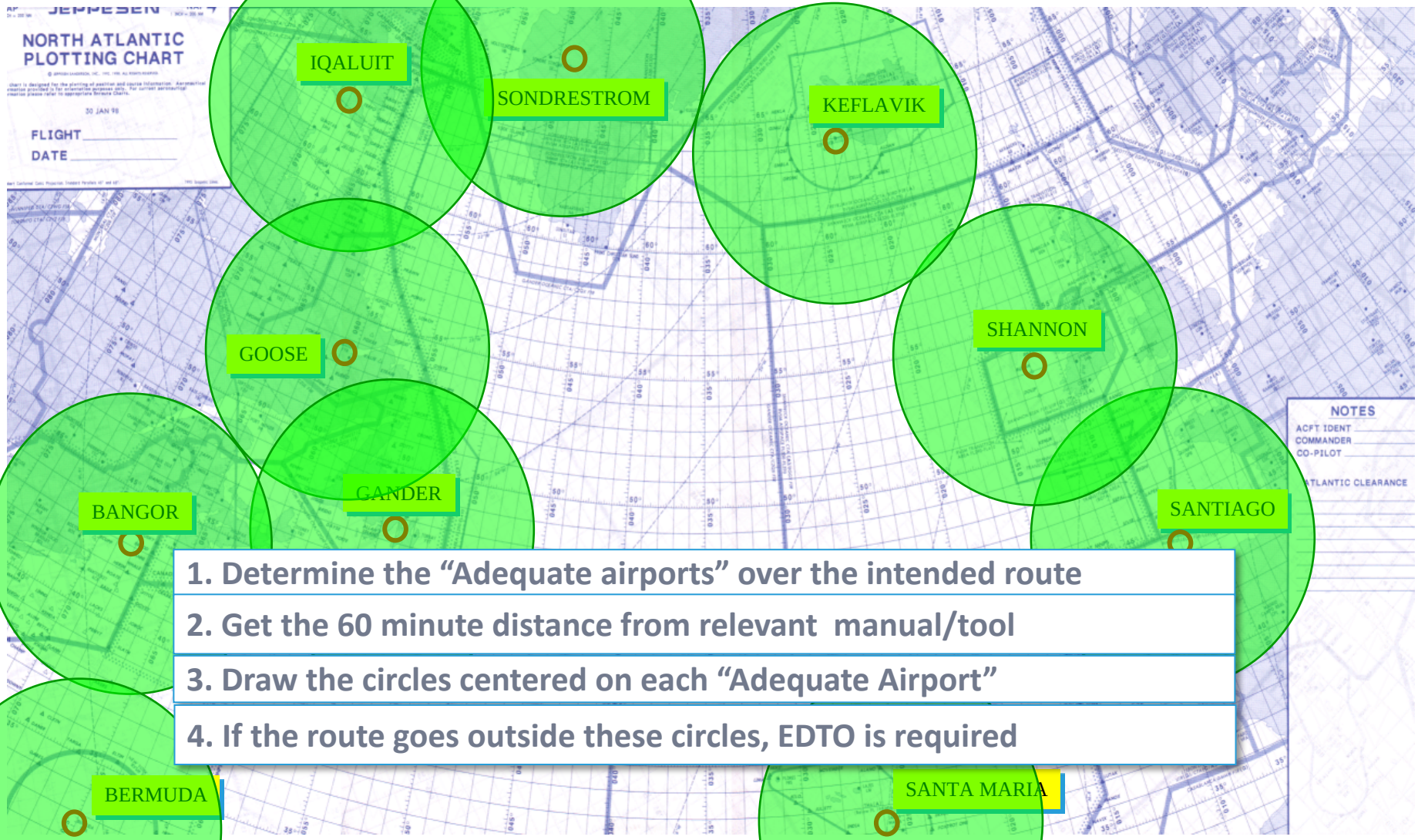
Threshold and diversion time?

- ✈ **Is EDTO required ?**
- ✈ **What is the needed diversion time ?**

- ✈ *Example: EDTO operations with a twin engine aircraft*

Area of operations – EDTO

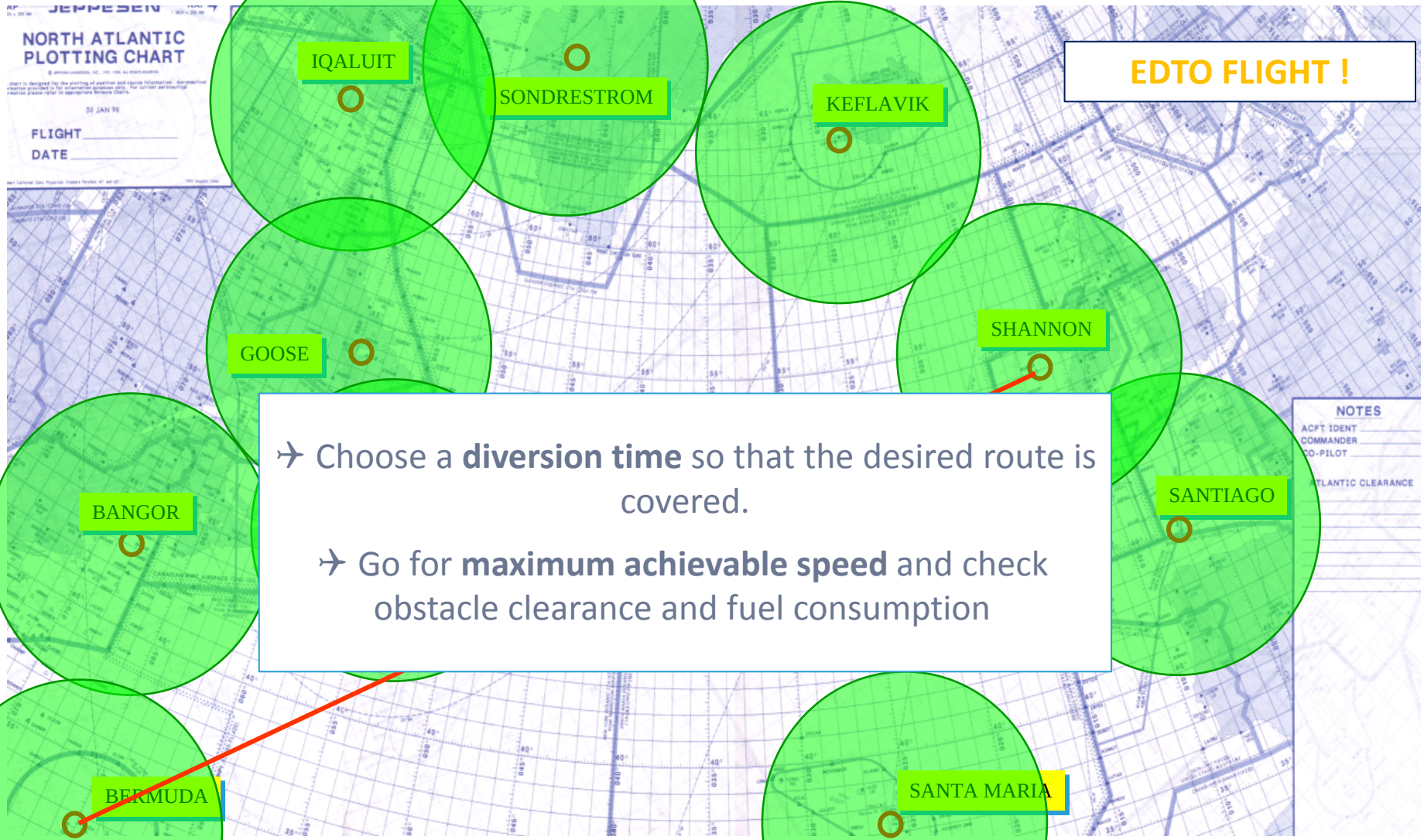
Threshold and diversion time (Cont)



1. Determine the “Adequate airports” over the intended route
2. Get the 60 minute distance from relevant manual/tool
3. Draw the circles centered on each “Adequate Airport”
4. If the route goes outside these circles, EDTO is required

Area of operations – EDTO

Threshold and diversion time (Cont)



- ✈ Choose a **diversion time** so that the desired route is covered.
- ✈ Go for **maximum achievable speed** and check obstacle clearance and fuel consumption

Area of operations – EDTO

Required EDTO diversion time)

A330 FLIGHT CREW OPERATING MANUAL	SPECIAL OPERATIONS EXTENDED RANGE OPERATIONS	2.04.40 P 11 SEQ 060 REV 06

ISA

SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN) 60	90	120	150	180
MCT/330KT	150000	200	443	661	879	1097	1316
	160000	190	442	658	873	1089	1305
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	180000	190	438	651	865	1080	1295
	190000	180	437	650	862	1075	1288
	200000	170	434	643	853	1063	1272
MCT/310 KT	150000	220	432	644	856	1069	1281
	160000	210	429	639	848	1058	1267
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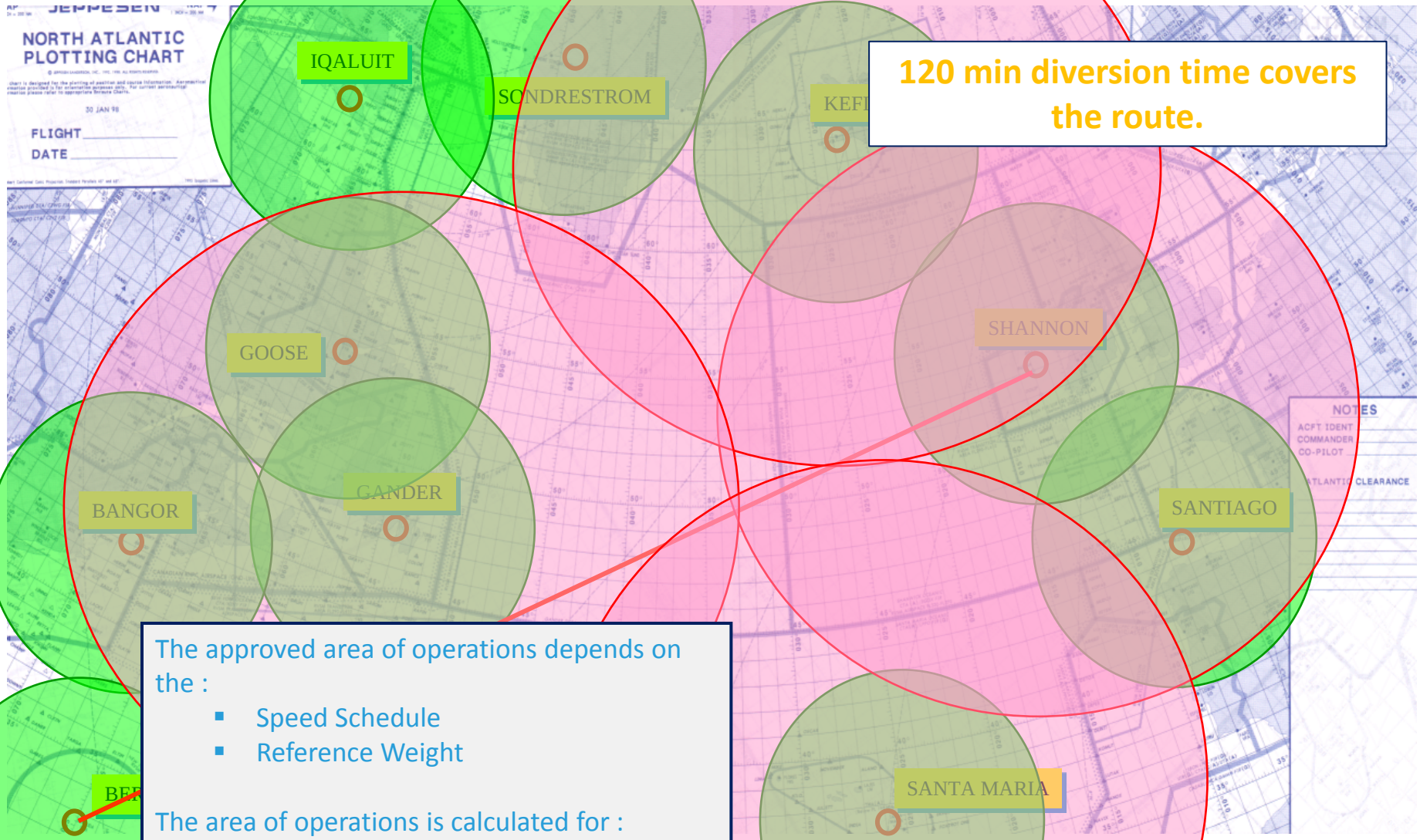
	200000	190	421	624	828	1031	1234

Area of operations – EDTO

Threshold and diversion time (Cont)



120 min diversion time covers the route.

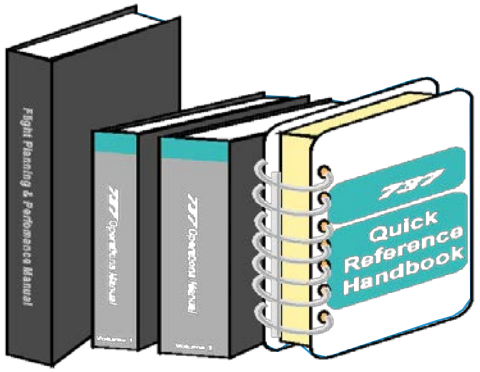
The approved area of operations depends on the :

- Speed Schedule
- Reference Weight

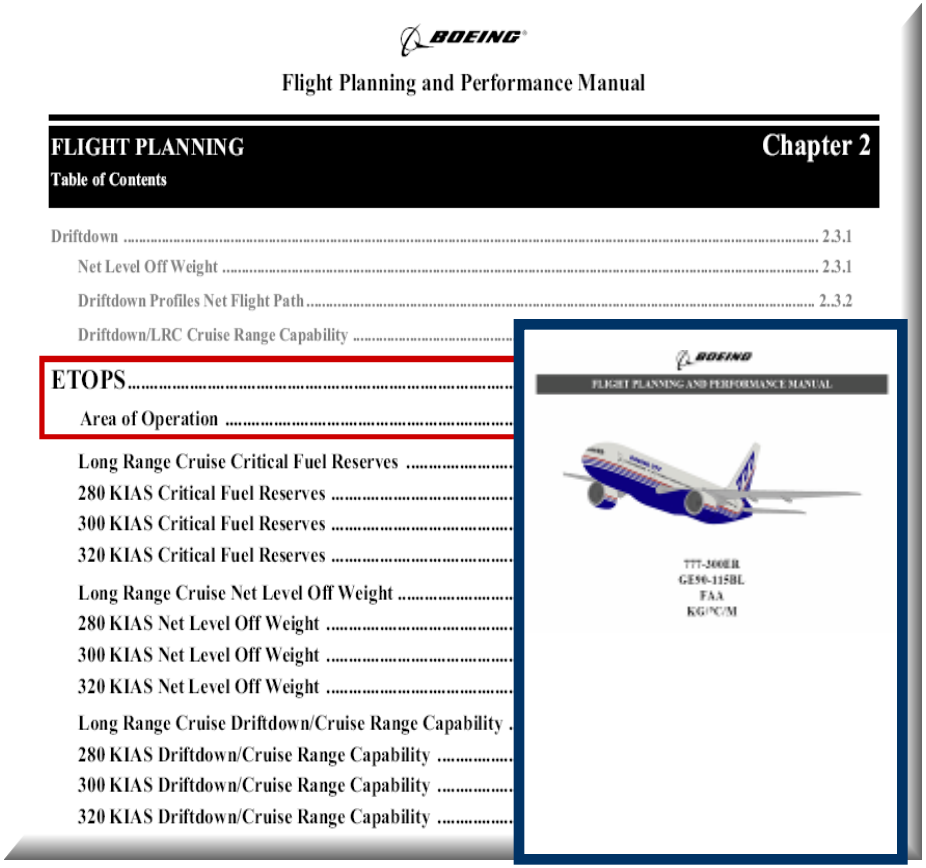
The area of operations is calculated for :

- ISA conditions (ΔISA)
- No wind

Airplane Performance Considerations



Boeing Flight Planning and Performance Manual (FPPM)



Section 2.4 provides EDTO Planning Information *

- EDTO Area of Operation (Diversion Distance)
- Net level off weight
- EDTO Critical Fuel Reserves
- Drift-down Cruise Range Capability

* Performance data for a range of engine inoperative speeds is included

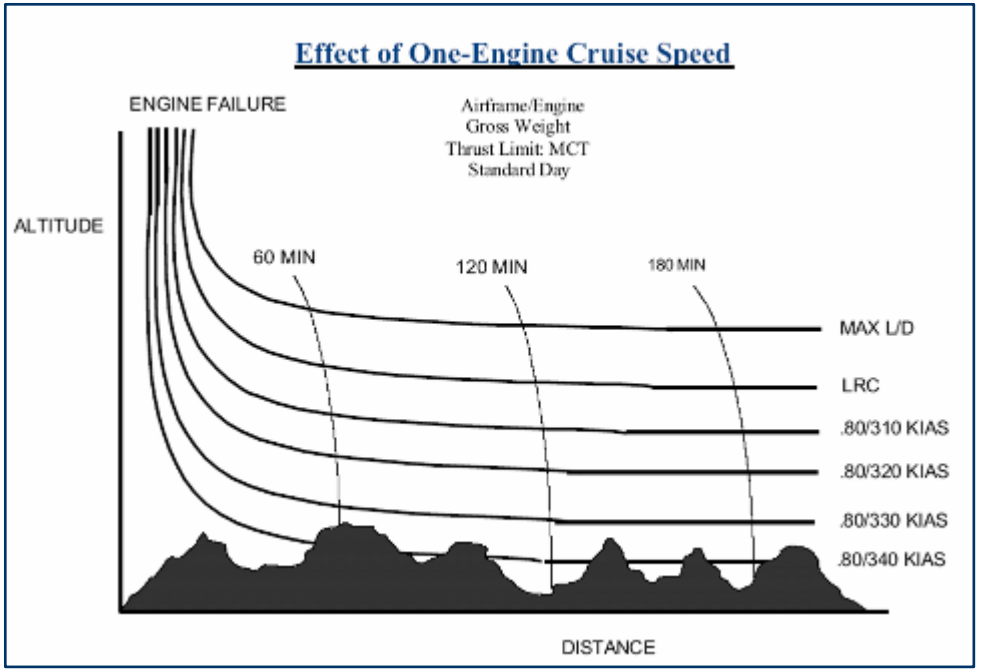
One-Engine Inoperative Cruise Speed

- A speed within the certified operating limits of the airplane that is specified by the certificate holder and approved by the FAA for

1) Calculating required fuel reserves needed to account for an inoperative engine;

or

2) Determining whether an EDTO alternate is within the maximum diversion time authorized for an EDTO flight

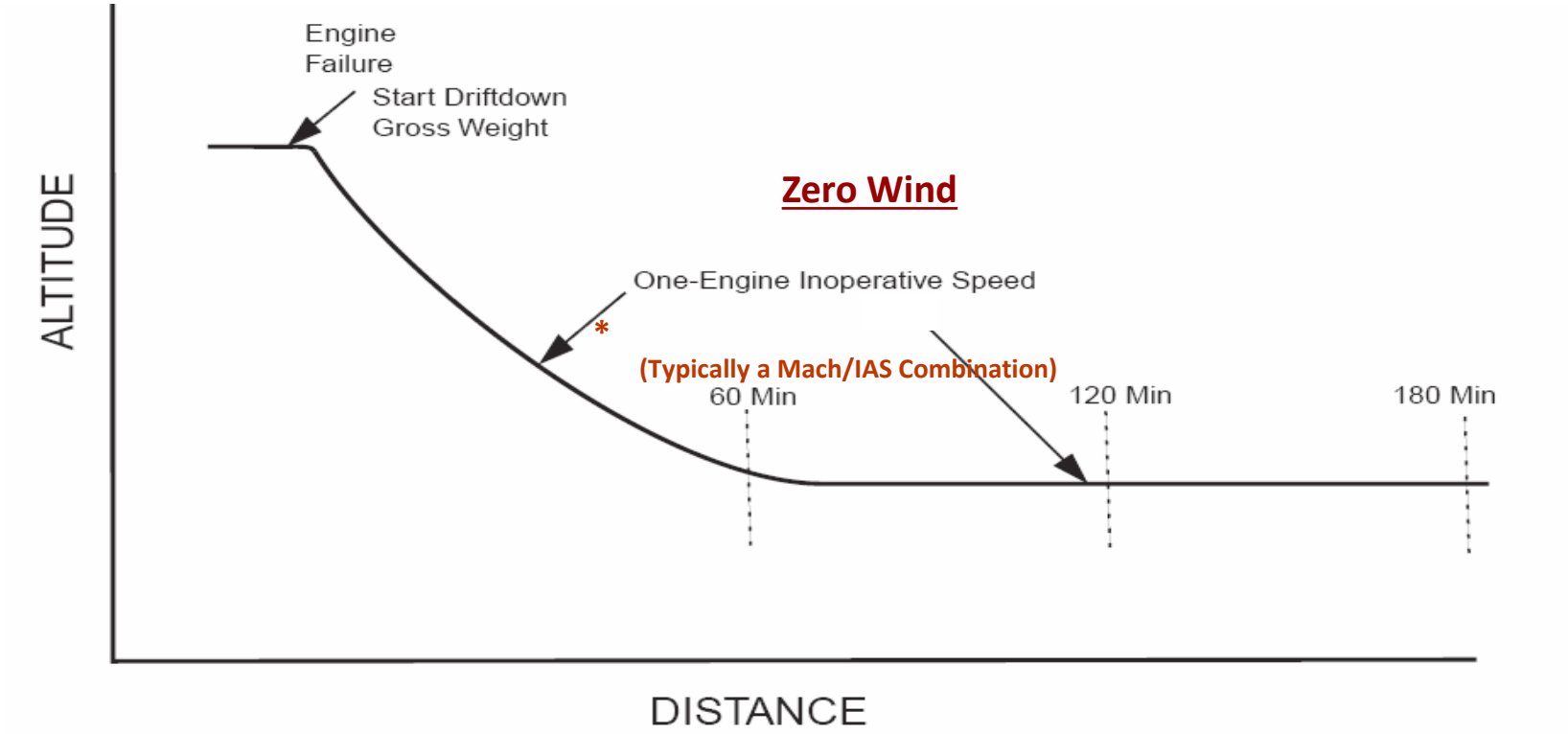


EDTO Area of Operation

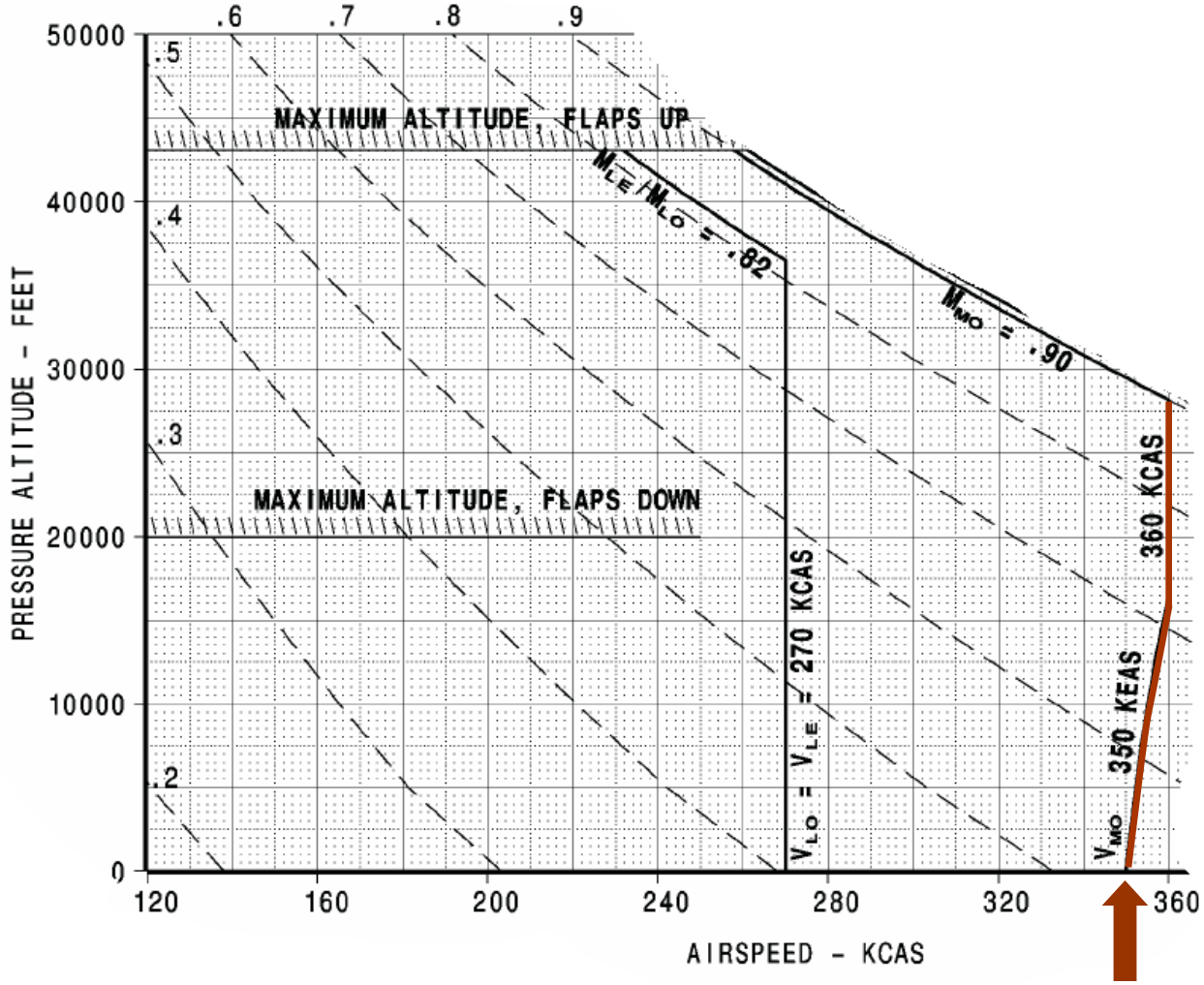
Diversion Distance

- Engine fails at normal cruise altitude
- MCT on operating engine(s)
- Driftdown at engine-out planning speed *
- Level off/cruise at thrust limited altitude

- Diversion Distance is a function of:
  - Diversion Time
  - Engine Inoperative Speed
  - Reference Weight



787-8 Operational Flight Envelope



- V_{LO}/M_{LO}

  Max Speed for Landing Gear Operation

- V_{LE}/M_{LE}

  Max Speed with Landing Gear Extended

- V_{MO}/M_{MO}

  Max Operating Limit Speed

Example

EDTO Diversion Distance

777-300ER / GE90-115BL

. . . *beyond 240*

SPEED (M/KIAS)	WEIGHT AT DIVERSION (1000 KG)	DIVERSION DISTANCE (NM) TIME (MINUTES)							
		60	75	90	120	138	180	207	240
.82/260	360	363	449	536	708	811	1052	1206	1395
	340	367	454	542	718	824	1070	1228	1422
	320	376	466	556	737	845	1098	1260	1458
	300	385	477	570	756	867	1127	1294	1498
	280	394	489	585	776	890	1158	1330	1540
	260	404	503	601	798	916	1192	13	1586
	240	415	517	619	822	944	1228		1634
	220	424	528	632	840	965	12		1672
	200	434	540	647	859	987			1710
	180	445	553	662	880	1010		1510	1749
	160	452	563	674	897	10		1541	1786
.84/280	360	384	477	570	756	867		1295	1499
	340	391	486	581	7	34	1149	1320	1528
	320	399	496	593			1173	1347	1560
	300	408	507	606	4	923	1200	1378	1596
	280	417	519	62	2	944	1227	1409	1632
	260	428	532	6	845	969	1261	1448	1677
	240	438	545		866	994	1294	1486	1722
	220	446	5	5	883	1015	1321	1518	1758
	200	454	5	677	899	1033	1345	1545	1790
	180	46	5	689	916	1052	1369	1573	1822
	160	4	583	698	928	1066	1389	1596	1849
.84/300	360		506	605	804	923	1200	1378	1596
	340	4	514	615	816	937	1219	1400	1622
	320	421	523	625	830	953	1239	1424	1649
	300	430	534	638	847	972	1264	1451	1680
	280	438	544	651	863	990	1288	1479	1712
	260	447	556	664	880	1010	1313	1508	1746
	240	455	566	677	898	1031	1341	1540	1784

Traditional FPPM Method

Performance Engineers Tool (PET)

Example Inputs & Outputs - EDTO Diversion Distance

New Method

Calculators | Data Managers | APM | Reporters

Operational Performance | Certified Performance (APM-DP1) | Results Manager

View : Airframe/Engine / Calculation Type

type filter text

- 747-8/GENX-2B67
- 747-8F/GENX-2B67
- 787-8/GENX-1B64
- 787-8/GENX-1B70
- 787-8/Trent1000
- 787-8/Trent1000-C
  - Takeoff (FAA)
  - Flight Path
  - Enroute
  - Mission
  - Landing (FAA)

787-8/Trent1000-C - Enroute

Calculation Type

Type: ETOPS

Calculation Mode

Calculation Option: Area of Operations

Airplane Configuration

Weight: 218500 kg

Ambient Conditions

Initial Altitude — Altitude: 35000 ft

Flight Profile

Driftdown and Cruise

Driftdown Speed Option: Airspeed/Mach

Mach: 0.85

Airspeed: 290,300,31(kts

Airspeed Type: KIAS

Power Setting: Continuous

Calculation Options

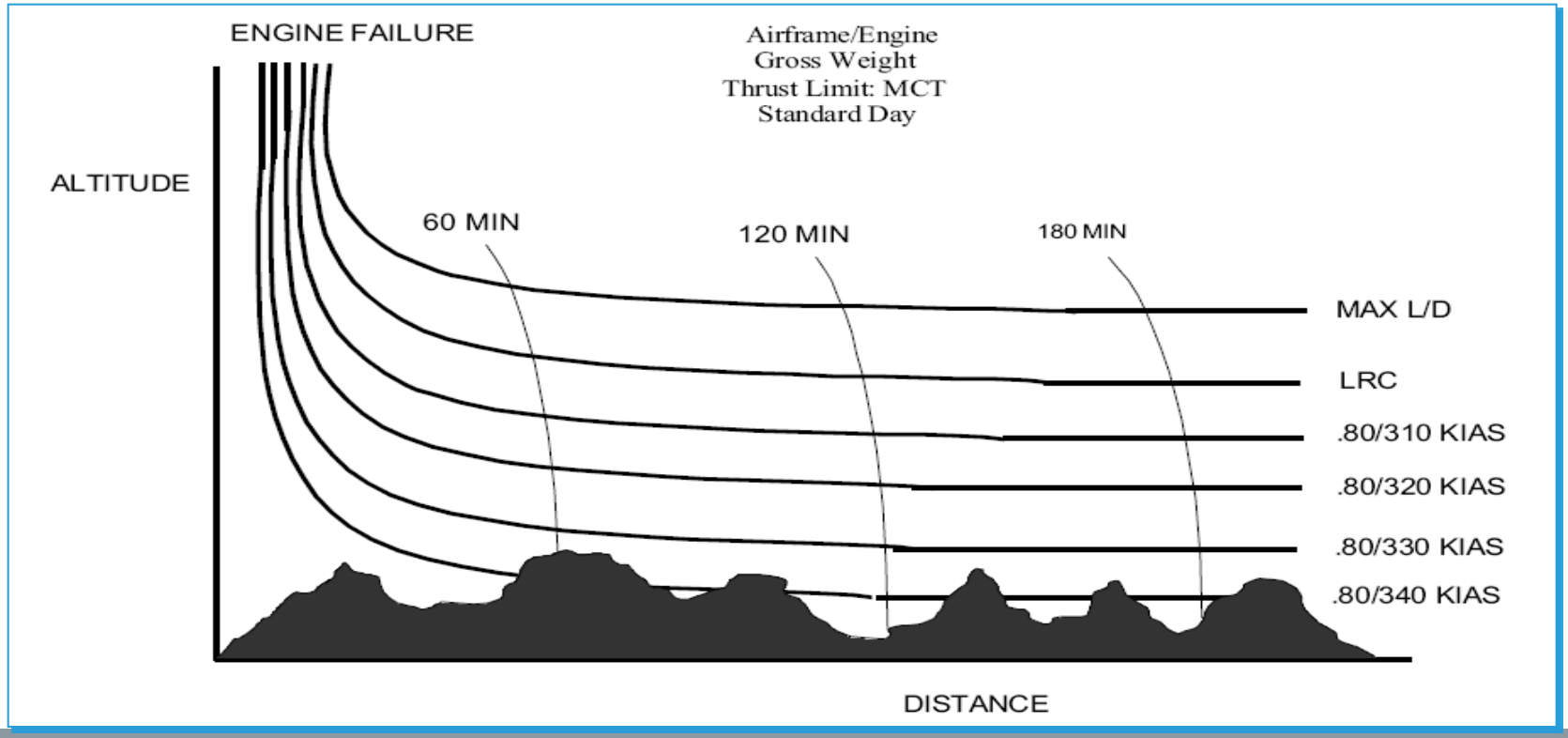
ETOPS Approval Time

ETOPS Approval Time: 60,75,(min

Info	No	ETOPS Approval Time (min)	Airspeed (kts)	Range (nm)	Total Fuel (kg)
	1	60.0	290.0	417.3241	5333.582
	8	75.0	290.0	516.1646	6790.021
	15	90.0	290.0	614.8907	8248.366
	22	120.0	290.0	812.3349	11145.97
	29	138.0	290.0	930.8015	12871.12
	36	180.0	290.0	1207.223	16857.21
	43	207.0	290.0	1384.923	19389.89
	50	240.0	290.0	1602.112	22454.88
	57	330.0	290.0	2194.445	30661.21
	2	60.0	300.0	424.4870	5534.166
	9	75.0	300.0	524.6713	7048.583
	16	90.0	300.0	624.7427	8564.539
	23	120.0	300.0	824.8800	11575.25
	30	138.0	300.0	944.9625	13368.39
	37	180.0	300.0	1225.155	17515.78
	44	207.0	300.0	1405.278	20156.05
	51	240.0	300.0	1625.429	23356.82

Effect of Engine
Out Cruise Speed

- Higher speeds (above Max L/D) reduce altitude capability
  - Terrain clearance, MORA considerations
  - True airspeed benefit versus altitude loss
- Higher speeds (above LRC) increase diversion fuel required



Effect of Engine Out Cruise Speed (Cont)

787-8 / TR-1000C

787-8 / TR-1000C
Reference Weight = 218,500 kg
Initial Altitude = 35,000 ft
PET Database: 878RCF.dat v1.2 dtd Oct 25, 2011

	DIVERSION DISTANCE (NM) TIME (MINUTES)								
SPEED (M/KIAS)	60	75	90	120	138	180	207	240	330
.85 / 290	417	516	614	812	930	1207	1384	1602	2194
.85 / 300	424	524	624	824	944	1225	1405	1625	2225
.85 / 310	431	532	633	835	956	1239	1420	1642	2248
.85 / 320	437	539	642	846	969	1255	1439	1664	2278
.85 / 330	443	547	651	860	985	1276	1464	1693	2318
.85 / 340	446	551	655	862	986	1276	1463	1690	2312
.85 / 350	448	551	652	856	978	1263	1446	1670	2280
LRC	411	508	605	798	913	1181	1351	1559	2120

Example

Agenda

- Defining the EDTO area of operations
- Performing EDTO Flight Planning
- Conducting EDTO Flights
- Conclusions

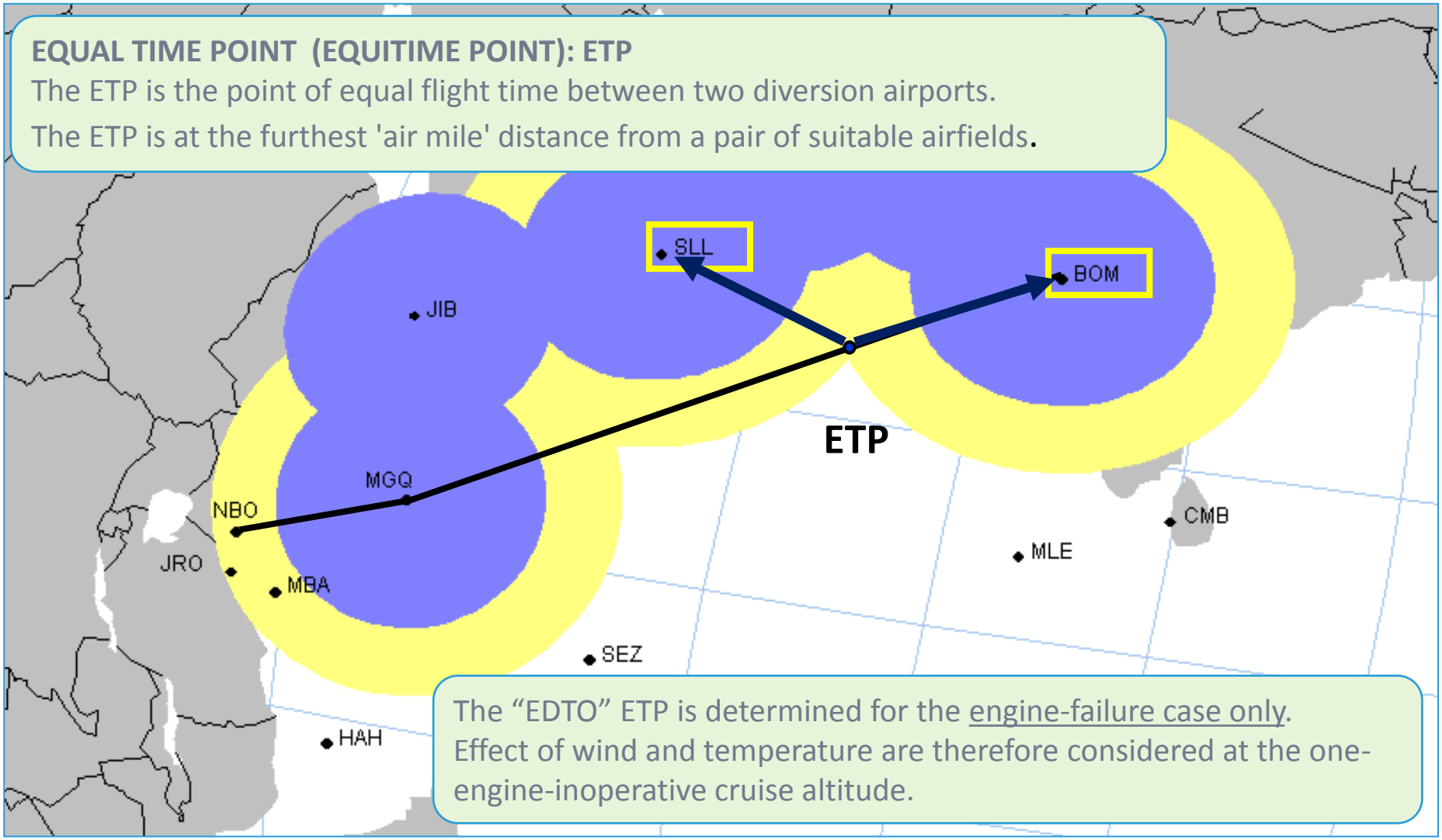
EDTO alternate aerodrome

Equal Time Point

EQUAL TIME POINT (EQUITIME POINT): ETP

The ETP is the point of equal flight time between two diversion airports.

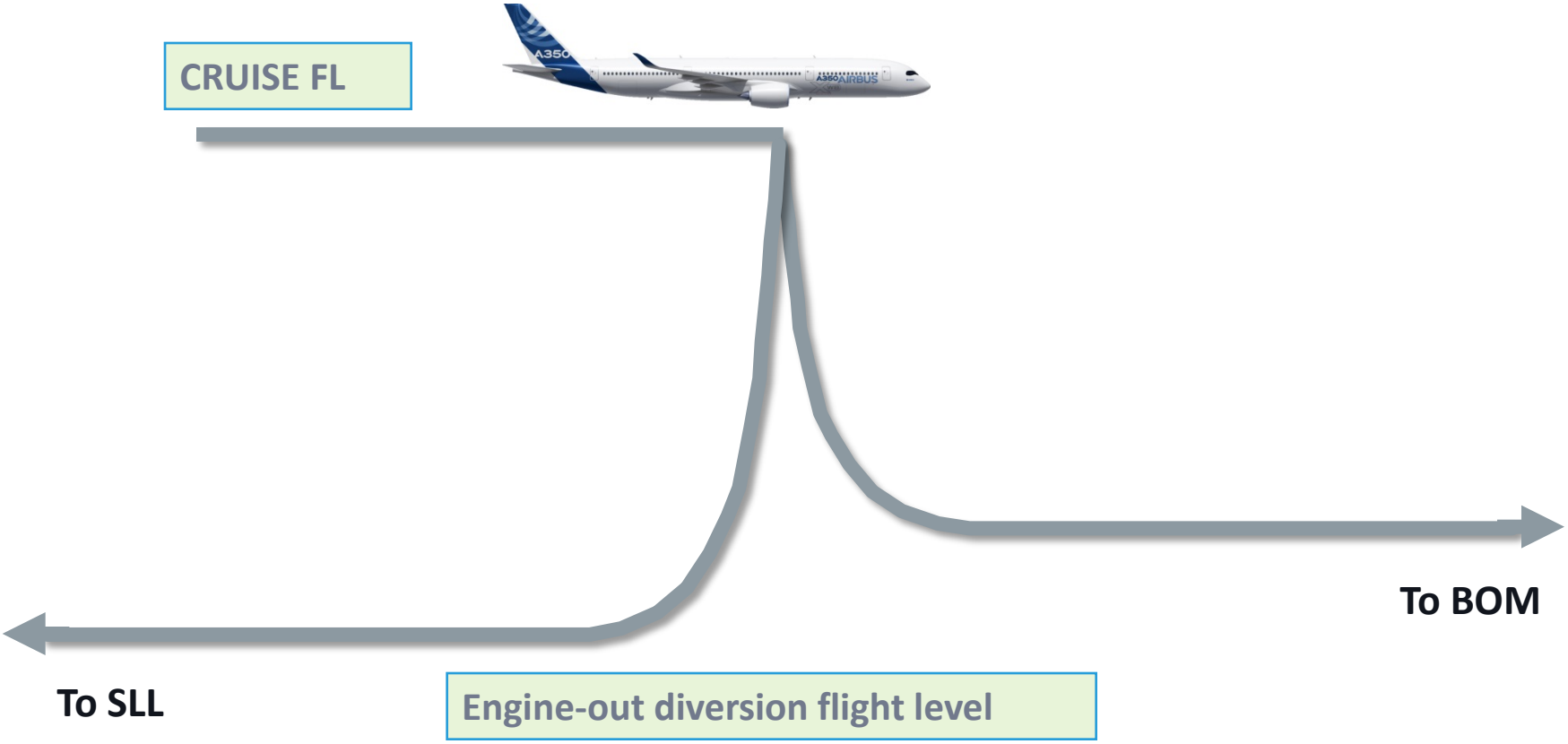
The ETP is at the furthest 'air mile' distance from a pair of suitable airfields.



The "EDTO" ETP is determined for the engine-failure case only. Effect of wind and temperature are therefore considered at the one-engine-inoperative cruise altitude.

EDTO alternate aerodrome

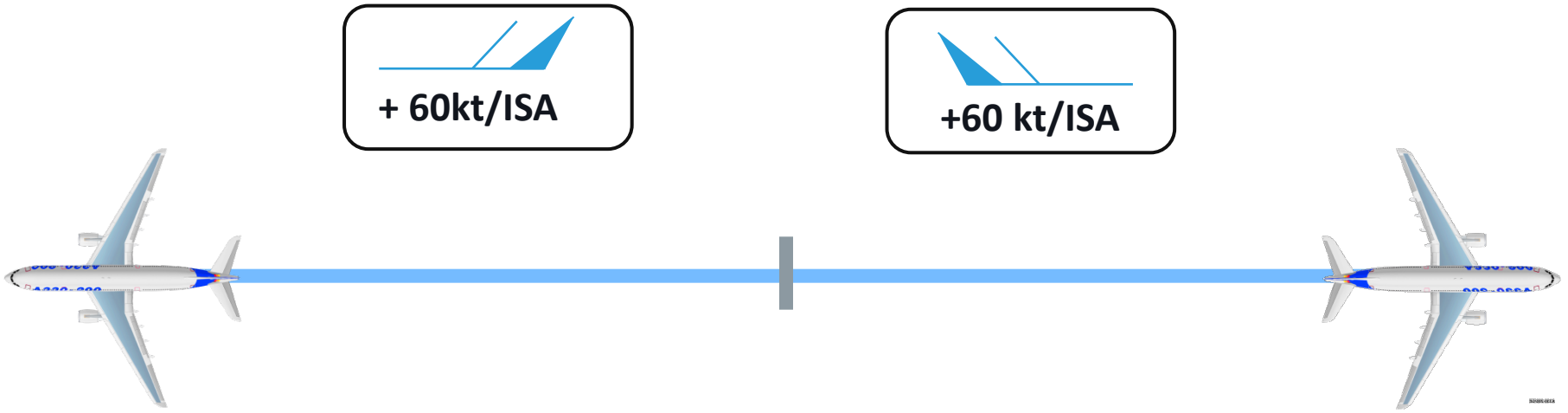
Time window ETP



EDTO alternate aerodrome

Time window ETP (Cont)

Let's assume the same conditions in both directions.

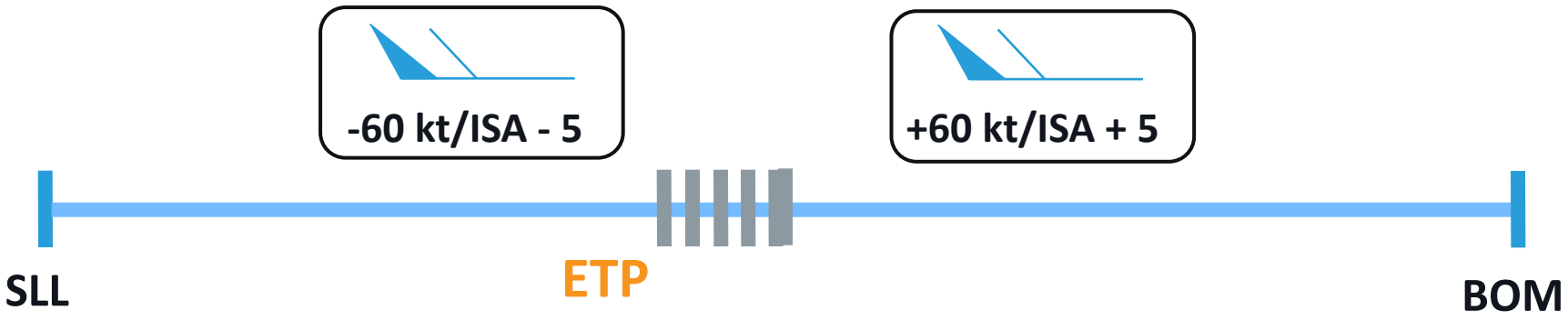


EDTO alternate aerodrome

Time window ETP (Cont)

Now, let's assume different conditions in both directions.

In which direction does the ETP move ?



✈ **To SLL ?**

Adverse Wind (Head), lower diversion FL and colder conditions (Reduced TAS)

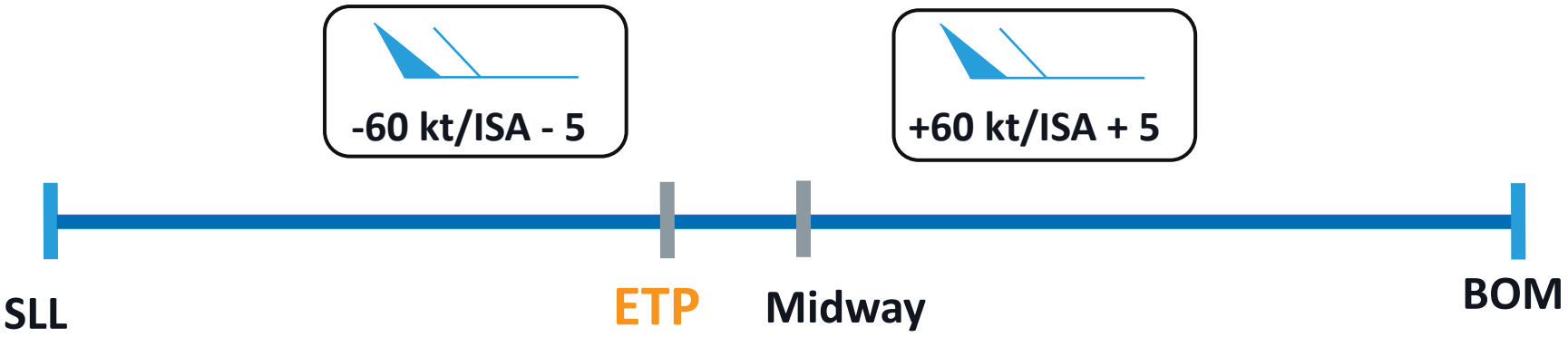
✈ **To BOM ?**

Favorable Wind (Tail), higher diversion FL and hot conditions (Increased TAS)

EDTO alternate aerodrome

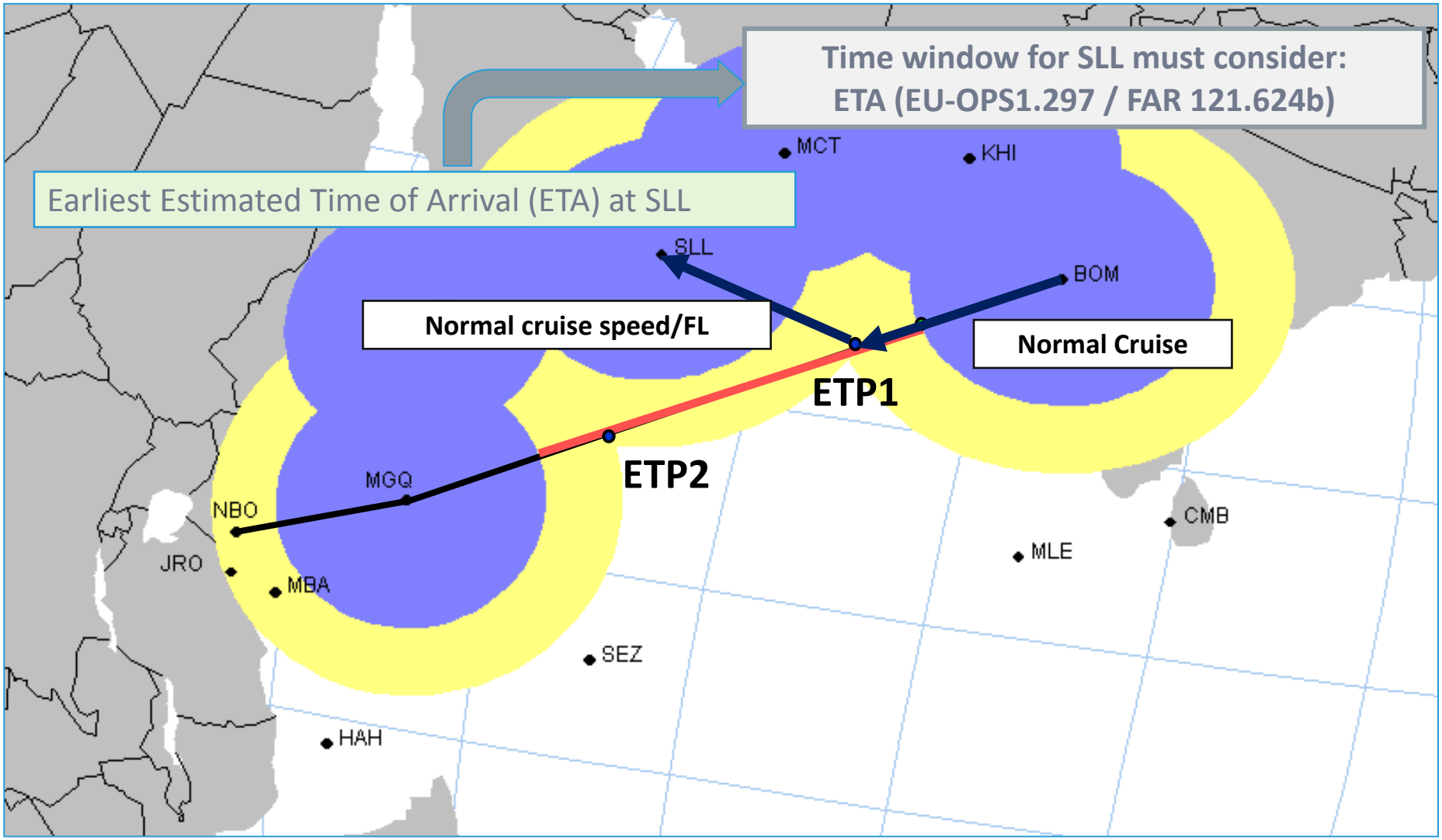
Time window ETP (Cont)

ETP takes into consideration Wind and Temperature effect at the engine-out diversion flight level.



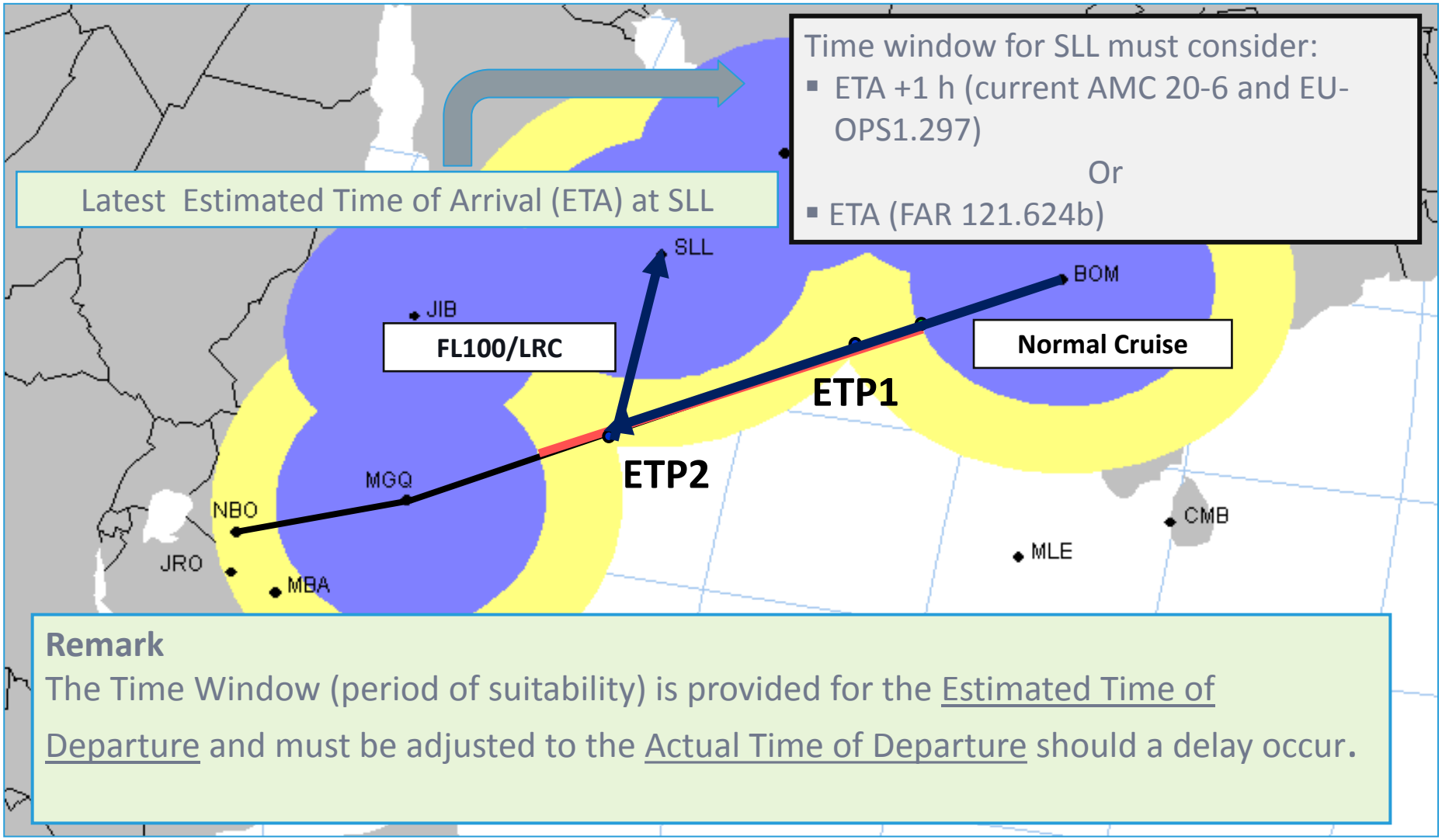
EDTO alternate aerodrome

Period of suitability, ETP, Time window



EDTO alternate aerodrome

Time window ETP (Cont)



Remark

The Time Window (period of suitability) is provided for the Estimated Time of Departure and must be adjusted to the Actual Time of Departure should a delay occur.

Fuel considerations

Fuel requirements

EASA AMC 20-6

FAA AC 120-42a

- Fuel from DEP to ETP (furthest point from the diversion Airport)

- Fuel to diversion Airport (from ETP)

+ Approach and Go-around
+ Circuit to land

+ Final reserve (15 minutes holding at 1500ft)
+ Specific reserves (contingency fuel, ice accretion, APU…)

EU-OPS 1.297 / AMC 20-6 Rev 2

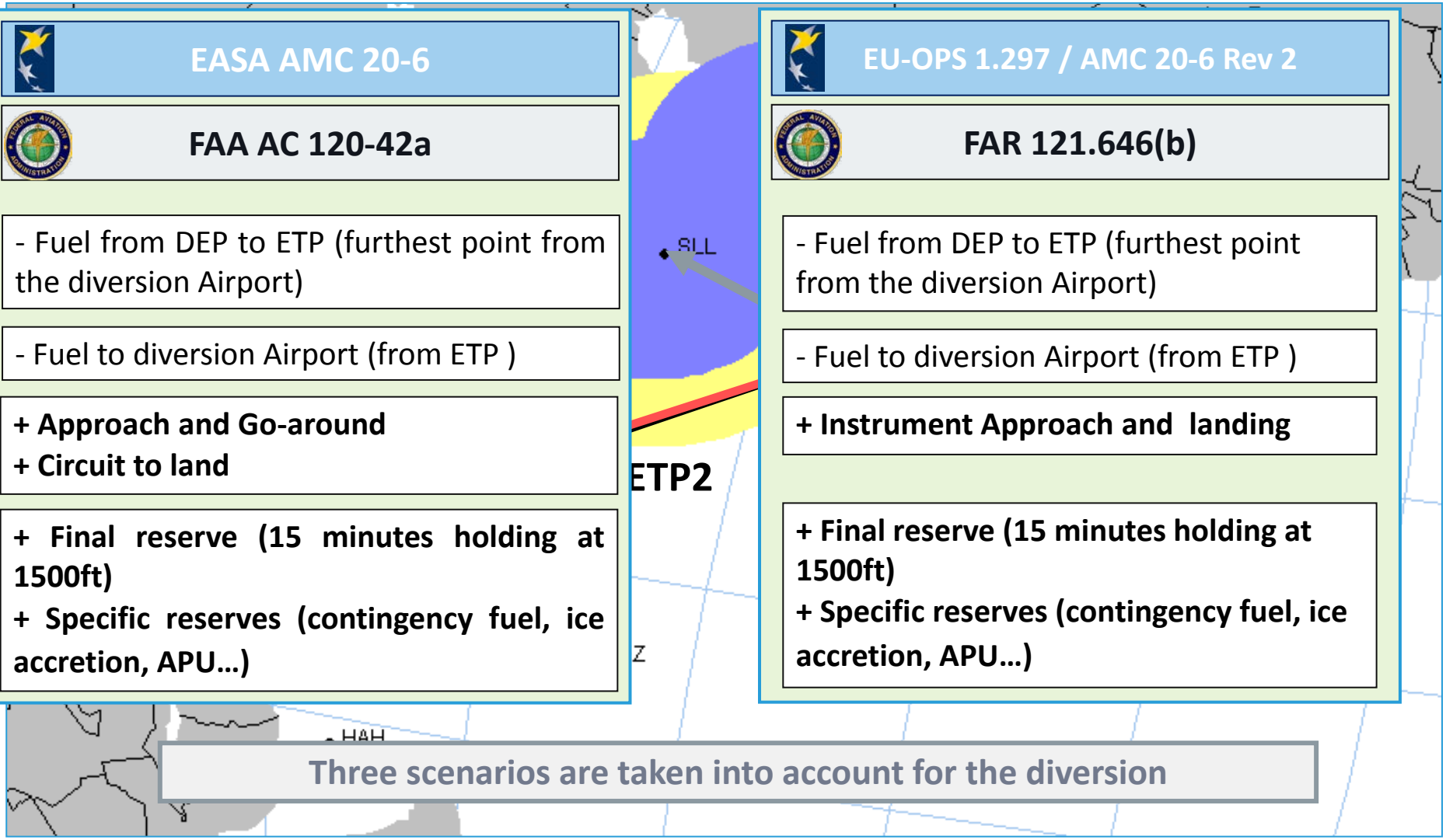
FAR 121.646(b)

- Fuel from DEP to ETP (furthest point from the diversion Airport)

- Fuel to diversion Airport (from ETP)

+ Instrument Approach and landing

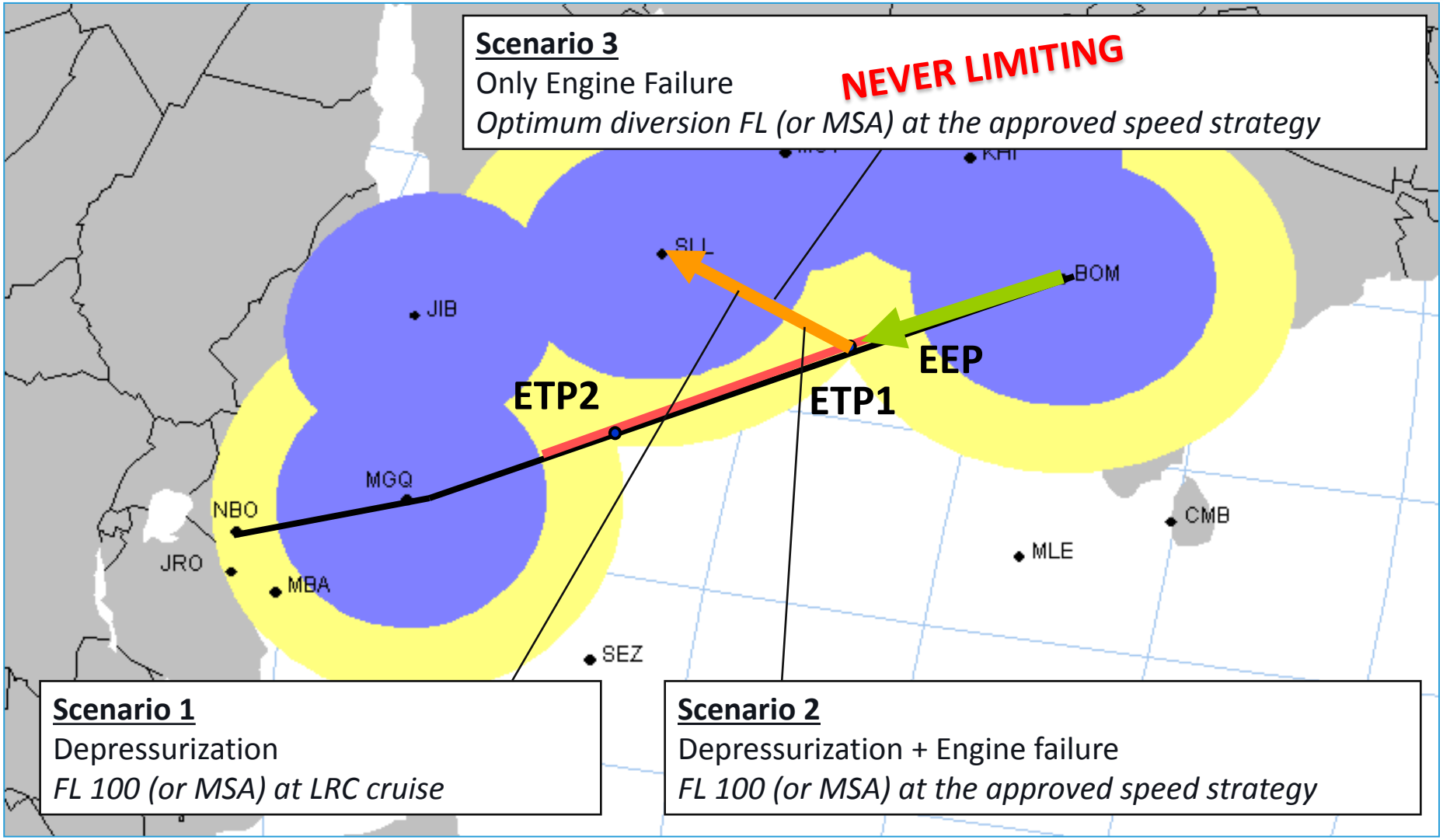
+ Final reserve (15 minutes holding at 1500ft)
+ Specific reserves (contingency fuel, ice accretion, APU…)



Three scenarios are taken into account for the diversion

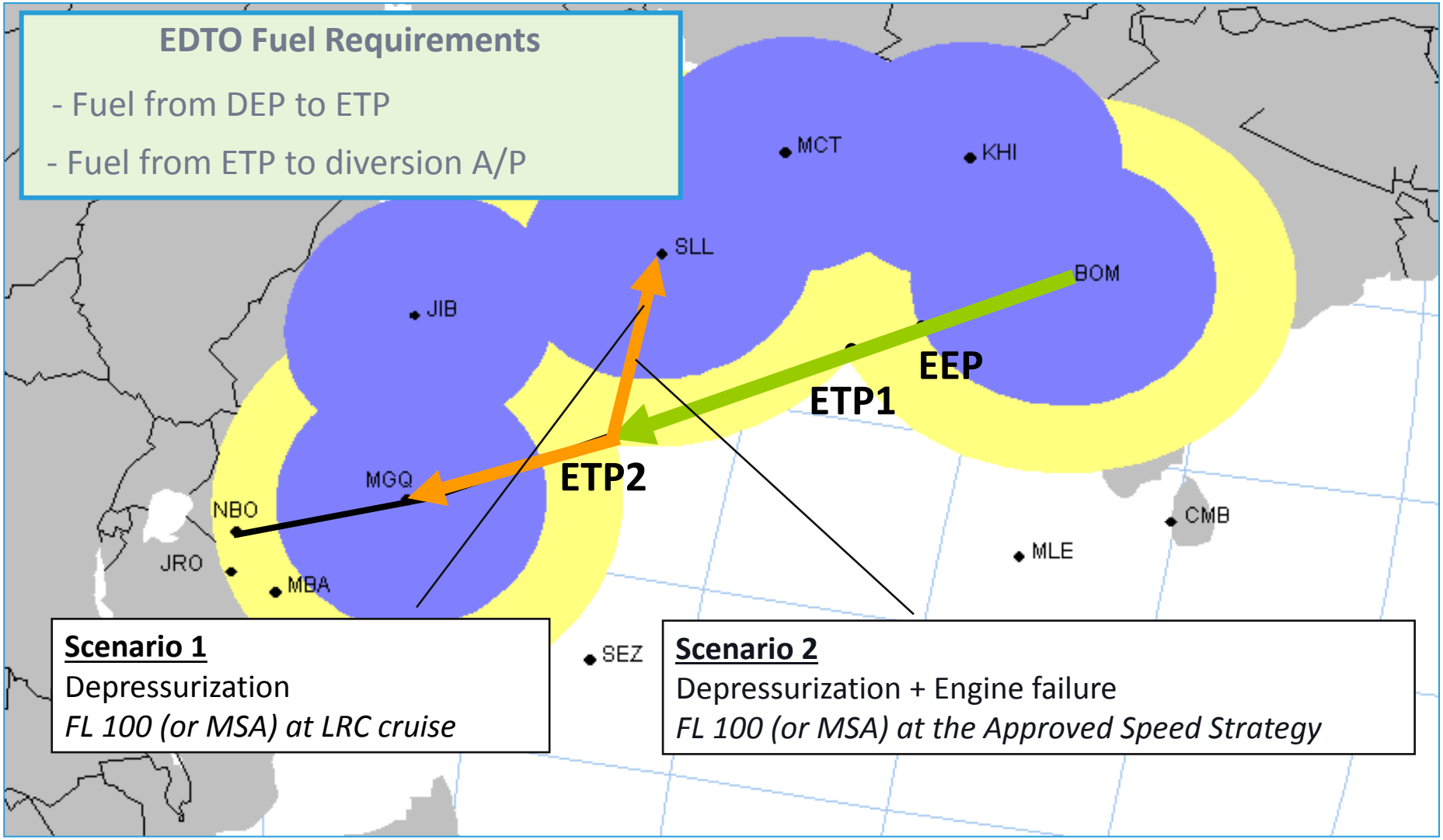
Fuel considerations

Fuel requirements (Cont)



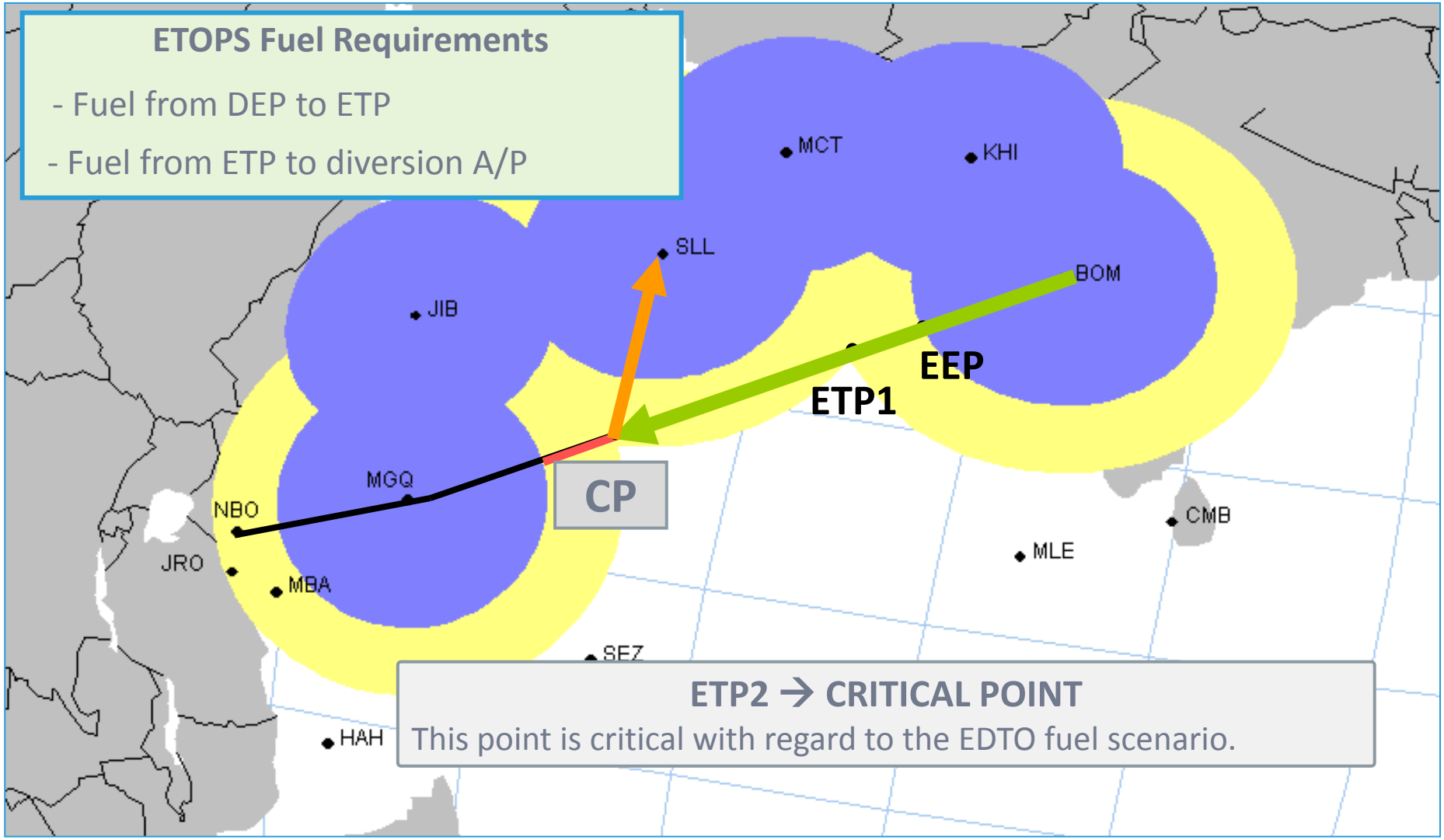
Fuel considerations

Fuel requirements (Cont)



Fuel considerations

Fuel requirements (Cont)



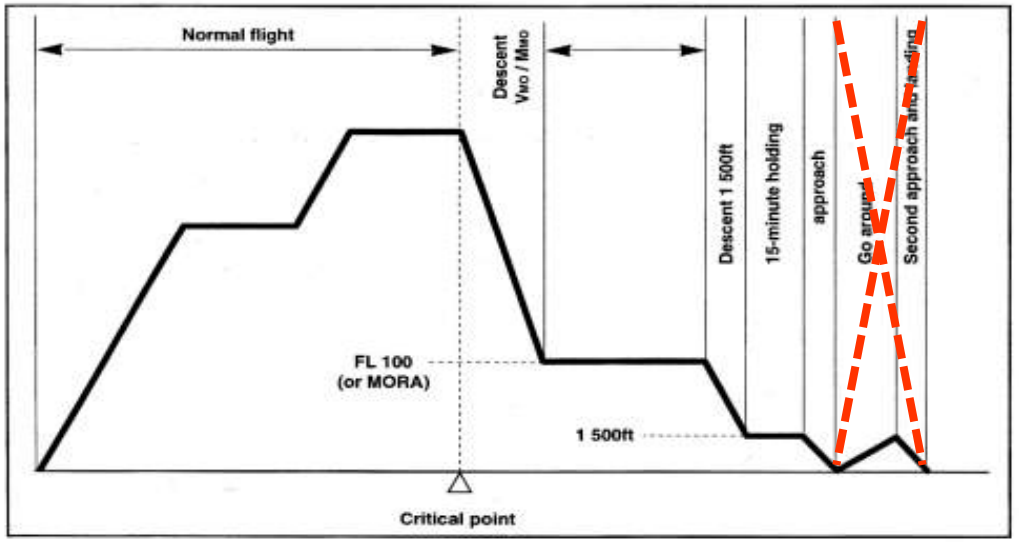
Fuel considerations

Fuel requirements new EDTO rules

Reduced "EDTO" Fuel Reserves

(compared to first ETOPS requirements)

1. Fly to the alternate airport
2. 15-minute holding at 1500 ft
3. Instrument approach and landing
4. ~~Go-around~~
5. ~~Visual approach and landing~~
6. Reduced "Additional fuel" for:
   - error in wind forecasting (5% wind factor instead of 5% diversion fuel)
   - Icing (effect of [Anti Icing] for 100% exposure time or [AI+icing drag] for 10% of exposure time only)



It may lead to up to 15% reduction in the EDTO Fuel

Fuel considerations

Fuel requirements Critical Point

Critical Point

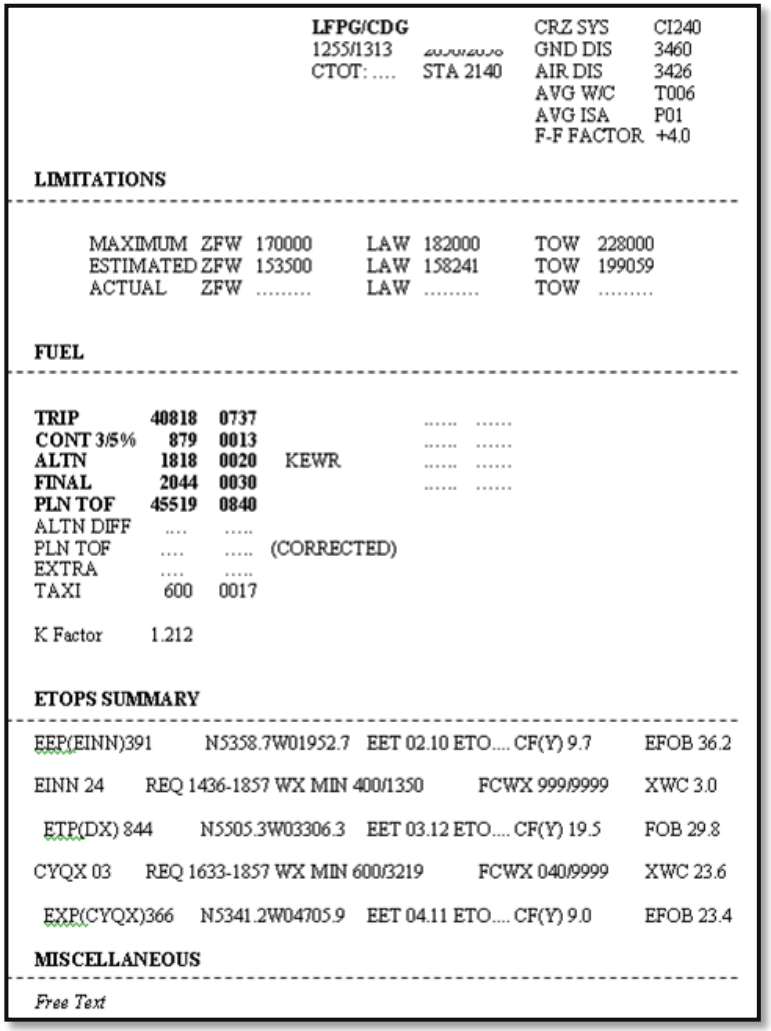
The point – among the equal time points (ETP) – on the route which is critical regards to the ETOPS fuel requirements if a diversion has to be initiated from that point .

Usually the last ETP within the EDTO segment

Fuel considerations

Fuel requirements Critical Point

- The standard fuel is still applicable, indeed, both standard and EDTO fuel requirements should be compared.
- Only, the most penalising one must be retained for dispatch
- As a matter of fact, EDTO fuel requirements are most of the time covered by the standard fuel.



LFPG/CDG
1255/1313
CTOT: ....
STA 2140

CRZ SYS CI240
GND DIS 3460
AIR DIS 3426
AVG W/C T006
AVG ISA P01
F-F FACTOR +4.0

LIMITATIONS

MAXIMUM	ZFW	170000	LAW 182000	TOW	228000
ESTIMATED	ZFW	153500	LAW 158241	TOW	199059
ACTUAL	ZFW	.....	LAW	TOW	.....

FUEL

TRIP	**40818**	**0737**		.....	.....
CONT 3/5%	**879**	**0013**		.....	.....
ALTN	**1818**	**0020**	KEWR	.....	.....
FINAL	**2044**	**0030**		.....	.....
PLN TOF	**45519**	**0840**			
ALTN DIFF	....	.....			
PLN TOF	....	.....	(CORRECTED)		
EXTRA	....	.....			
TAXI	600	0017			

K Factor 1.212

ETOPS SUMMARY

EEP(EINN)391 N5358.7W01952.7 EET 02.10 ETO.... CF(Y) 9.7 EFOB 36.2

EINN 24 REQ 1436-1857 WX MIN 400/1350 FCWX 999/9999 XWC 3.0

ETP(DX) 844 N5505.3W03306.3 EET 03.12 ETO.... CF(Y) 19.5 FOB 29.8

CYQX 03 REQ 1633-1857 WX MIN 600/3219 FCWX 040/9999 XWC 23.6

EXP(CYQX)366 N5341.2W04705.9 EET 04.11 ETO.... CF(Y) 9.0 EFOB 23.4

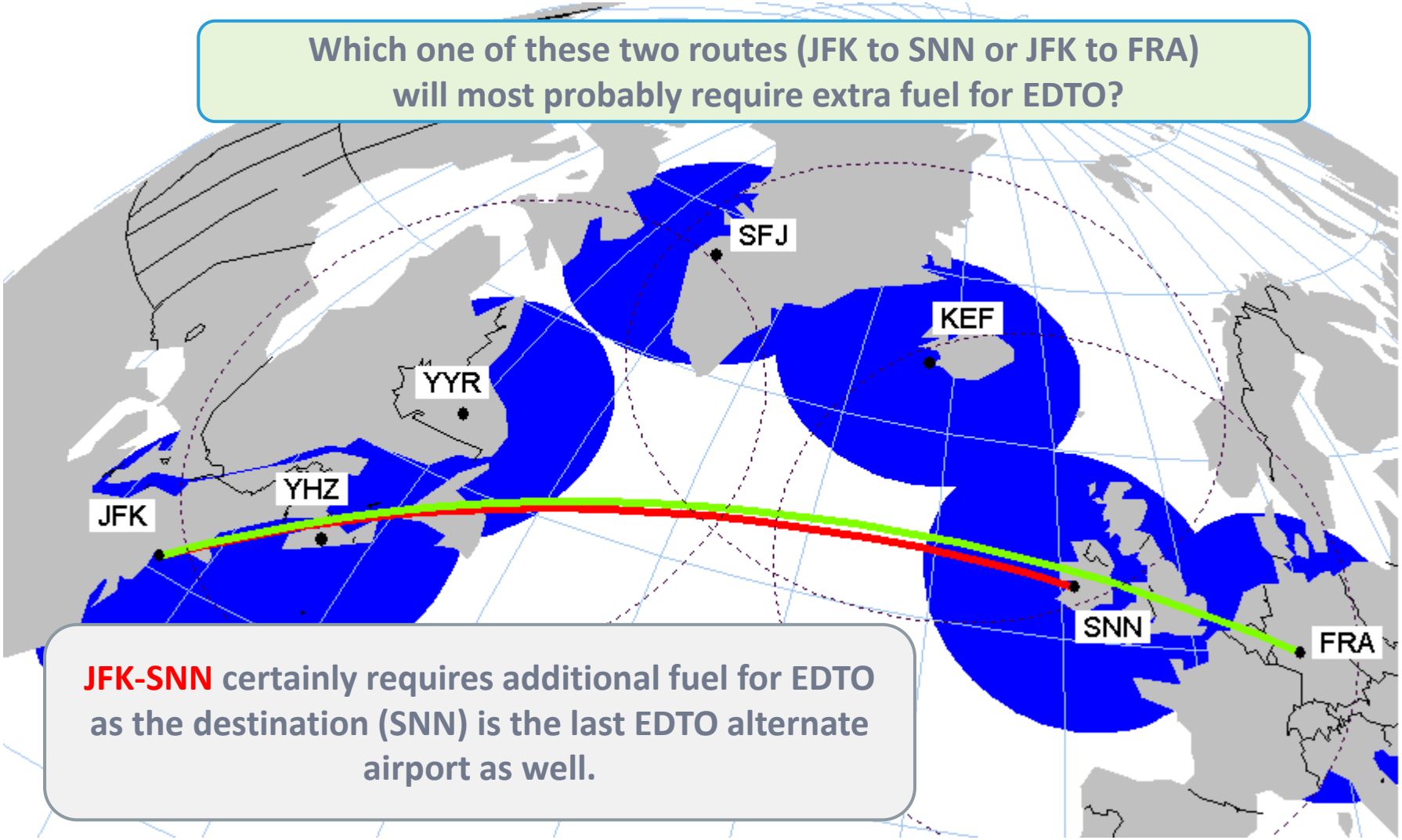
MISCELLANEOUS

Free Text

Fuel considerations

Fuel requirements Extra Fuel

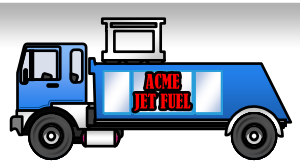
Which one of these two routes (JFK to SNN or JFK to FRA) will most probably require extra fuel for EDTO?



JFK-SNN certainly requires additional fuel for EDTO as the destination (SNN) is the last EDTO alternate airport as well.

EDTO Critical Fuel Scenario

FAR 121.646(b) and EASA AMC 20-6 Appendix 4



- Most limiting of the following scenarios at critical Equal Time Point between EDTO Alternates
  - Engine failure
  - Depressurization
  - Engine failure and depressurization (combined failure)
- Engine out fuel based on selected EDTO planning speed,
  all engine fuel based on LRC speed
- 15-minute hold at destination and fuel allowances
- Fuel Adjustments
  - Wind forecast errors, Temperature
  - Fuel burn deterioration (5% or established in-service value)
  - Forecast Icing, APU fuel burn, MEL/CDL
- New FAA and EASA rules provide significant fuel relief relative to previous guidelines

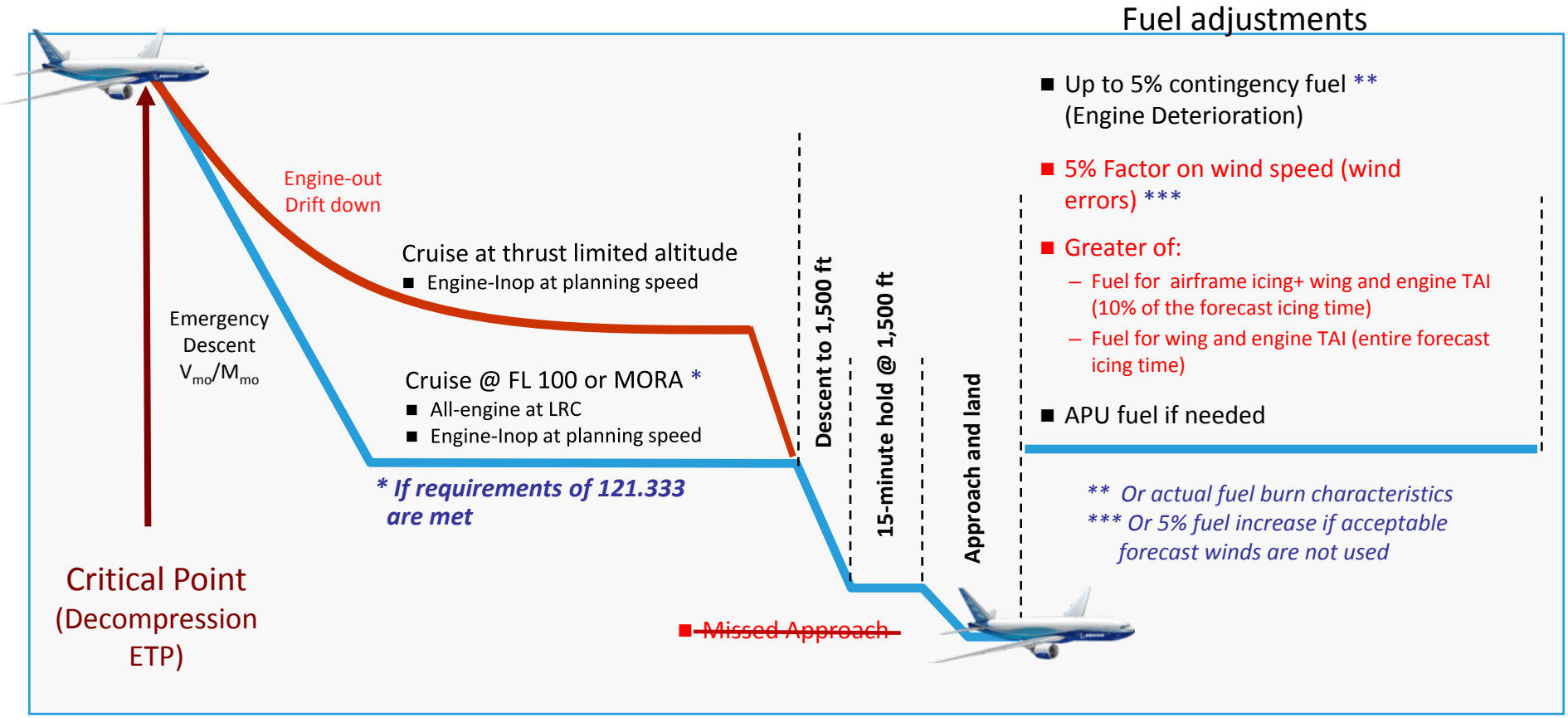
FAR 121-646 (b), EASA AMC 20-6, Appendix 4*

Cabin decompression, engine failure or both at critical ETP

(Compare higher of three fuel values to normal fuel load)

Differences from AC 120-42A noted in red

Forecast winds and temperatures

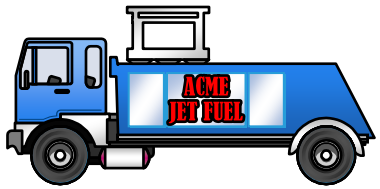


** New rules provide significant relief relative to previous standards*

EDTO Critical Comparison*

787-8 / GENX-1B70

787-8 / GENX-1B70
GW = 200,000 KG
Diversion Distance = 1000 nm
Nil wind, standard day, no icing
Nominal Performance
PET v1.6 Database: 878G70.dat v1.1 Nov 17, 2011



Example

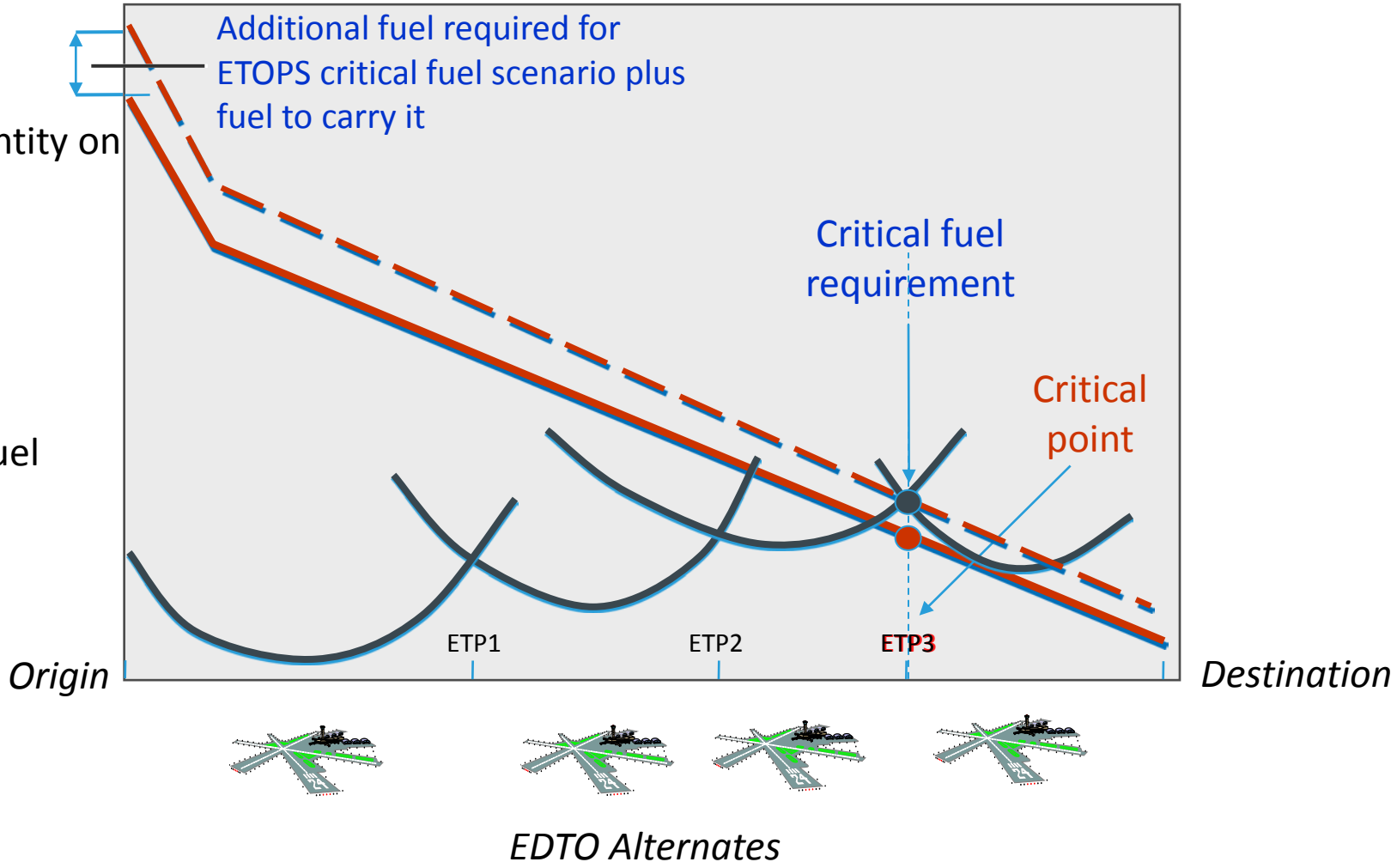
Engine Inoperative Speed	All Engine Decompression Fuel (LRC)	Engine Inop Driftdown Fuel	Engine Inop Decompression Fuel
290 KIAS	**16,571 KG**	13,146 KG	16,240 KG
300 KIAS	**16,571 KG**	13,507 KG	16,225 KG
310 KIAS	**16,571 KG**	13,812 KG	16,522 KG
320 KIAS	"	14,242 KG	**16,702 KG**
330 KIAS	"	14,701 KG	**16,956 KG**
340 KIAS	"	15,111 KG	**17,478 KG**

** Operational conditions may change these relationships*

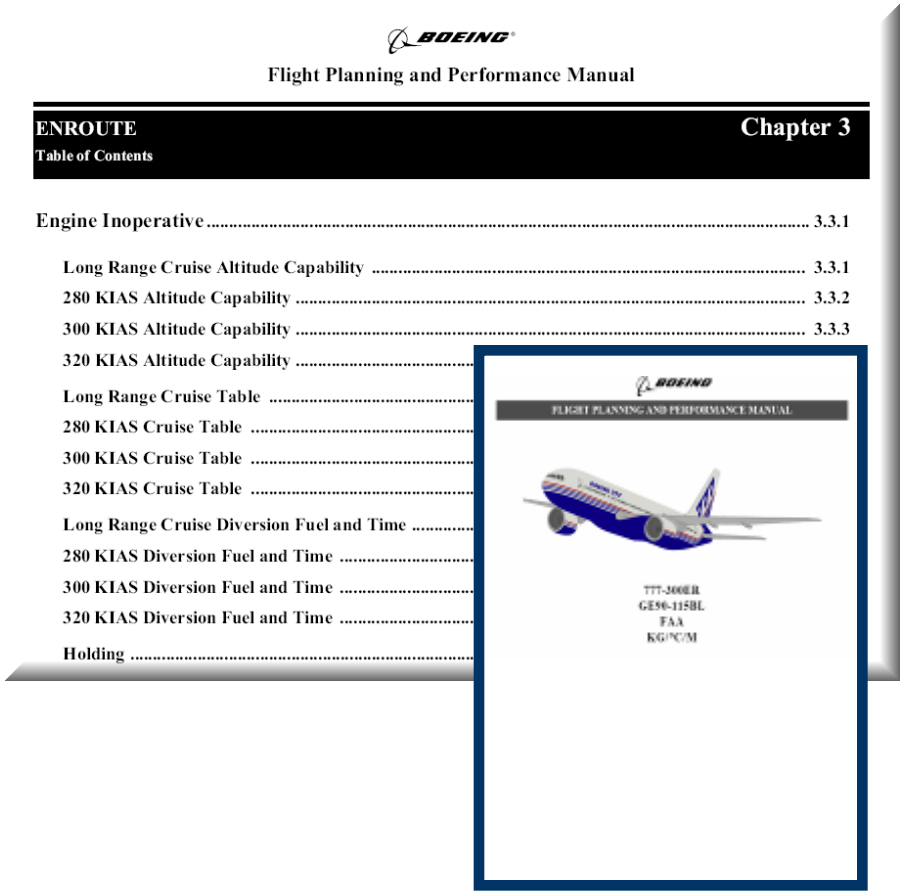
EDTO Critical
Operational Application

Check normal planned fuel load at critical point against critical fuel requirement

Example: Critical fuel uplift required



Traditional Boeing FPPM data for earlier models



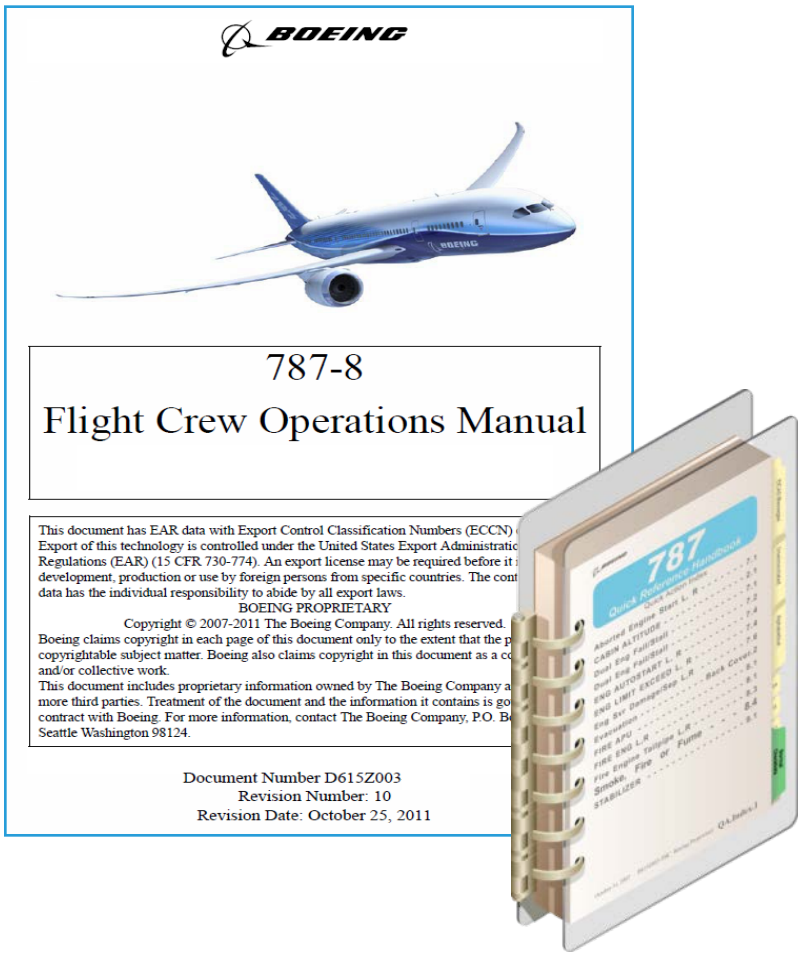
Section 3.3 provides EDTO En-route Performance *

- Altitude Capability
- Cruise Tables
- Diversion Fuel and Time
- Holding

FPPM is not provided for 787

* Performance data for a range of engine inoperative speeds is included

Not intended for EDTO Planning



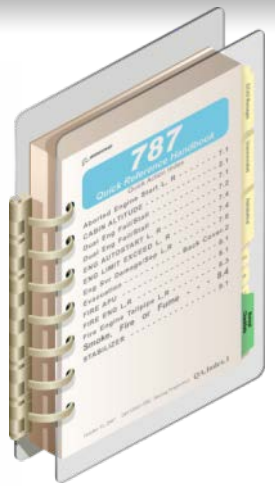
QRH PI Section provides *'get you home'* engine inoperative performance *

- Max Continuous Power
- Optimum driftdown speed, level off altitude and range capability (LRC cruise)
- LRC altitude capability, cruise control, diversion fuel/time
- Holding

* LRC and optimum drift down speed only (EDTO planning speeds not included)

QRH PI - Driftdown Speed/Level Off Altitude

787-8 / GENX-1B70



787-8/GENX-1B70
FAA
Category A Brakes

BOEING

787 Flight Crew Operations Manual

Performance Inflight - QRH
Engine Inoperative

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
240	231	266	18400	16900	15500
230	222	261	20100	18500	17100
220	213	256	21400	20100	18700
210	203	250	22700	21500	20300
200	194	245	24100	22900	21700
190	184	239	25400	24300	23100
180	174	232	26700	25800	24600
170	165	226	28000	27500	26300
160	155	220	29500	29200	28100
150	145	213	30900	30800	29900
140	136	206	32300	32200	31800
130	126	199	33700	33700	33600
120	116	192	35300	35300	35200
110	107	185	37000	36900	36800
100	97	178	38800	38700	38600

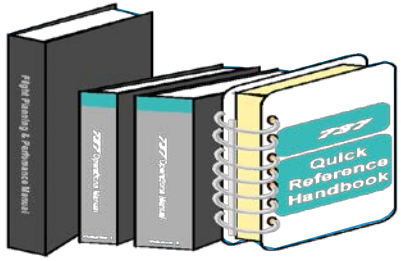
Includes APU fuel burn.

Example

EDTO Performance Considerations

Engine Inoperative Diversion Strategies

Diversion speed and thrust selection are at the discretion of the flight crew based on prevailing operational conditions



- ‘Obstacle Clearance’ Strategy
  - Best altitude profile for terrain clearance
  - Optimum driftdown (L/D max) speed *(QRH)*

Altitude

- ‘Fuel’ Strategy
  - Best fuel burn performance
  - Fixed speed descent to LRC cruise ceiling followed by LRC cruise *(QRH)*

Fuel

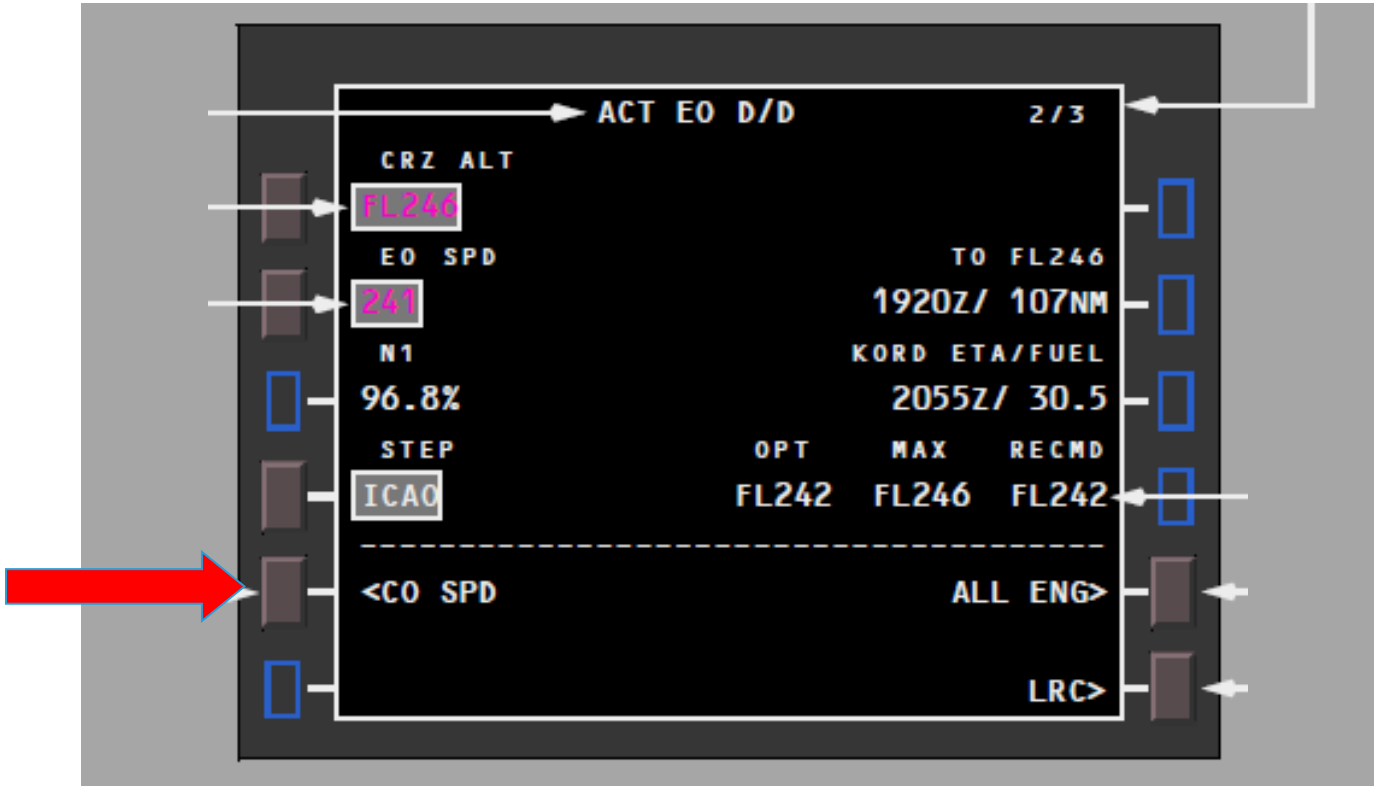
- ‘Fixed Speed’ (EDTO) Strategy
  - Minimum diversion time (at the expense of fuel and altitude)
  - Driftdown and cruise at EDTO planning speed *(PET only for 787)*

Time

EDTO Flight Crew Considerations

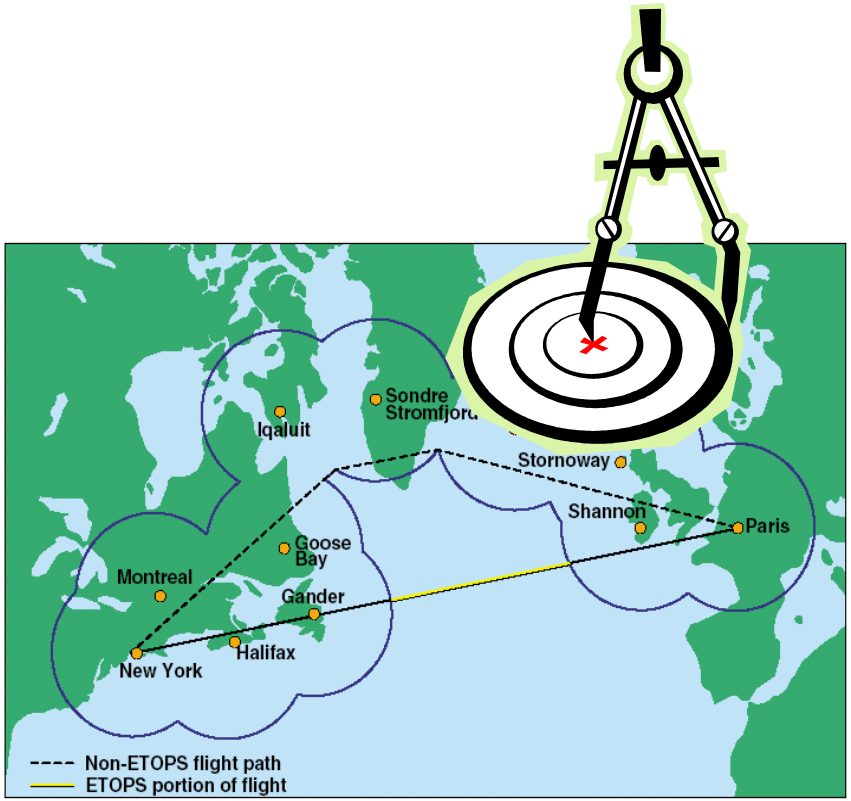
FMC Engine Out Cruise - 787

- Displays performance for each of the three engine inoperative speed strategies*



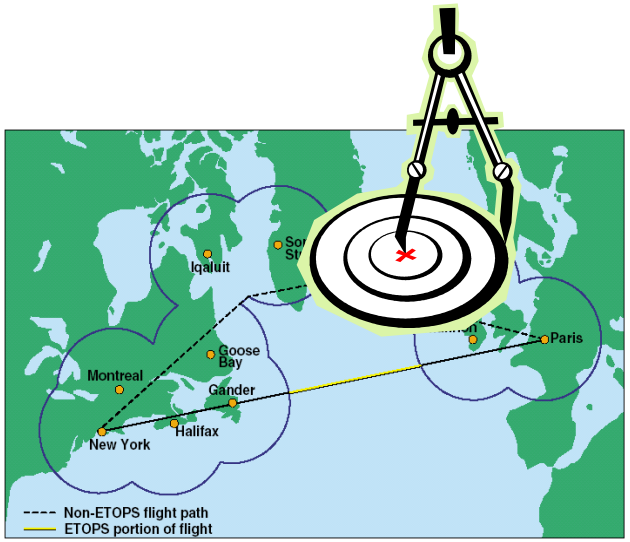
** EDTO speed (CO SPD) must be provided by operator for AMI load*

EDTO Approval Route Planning



EDTO Approval Route Planning*

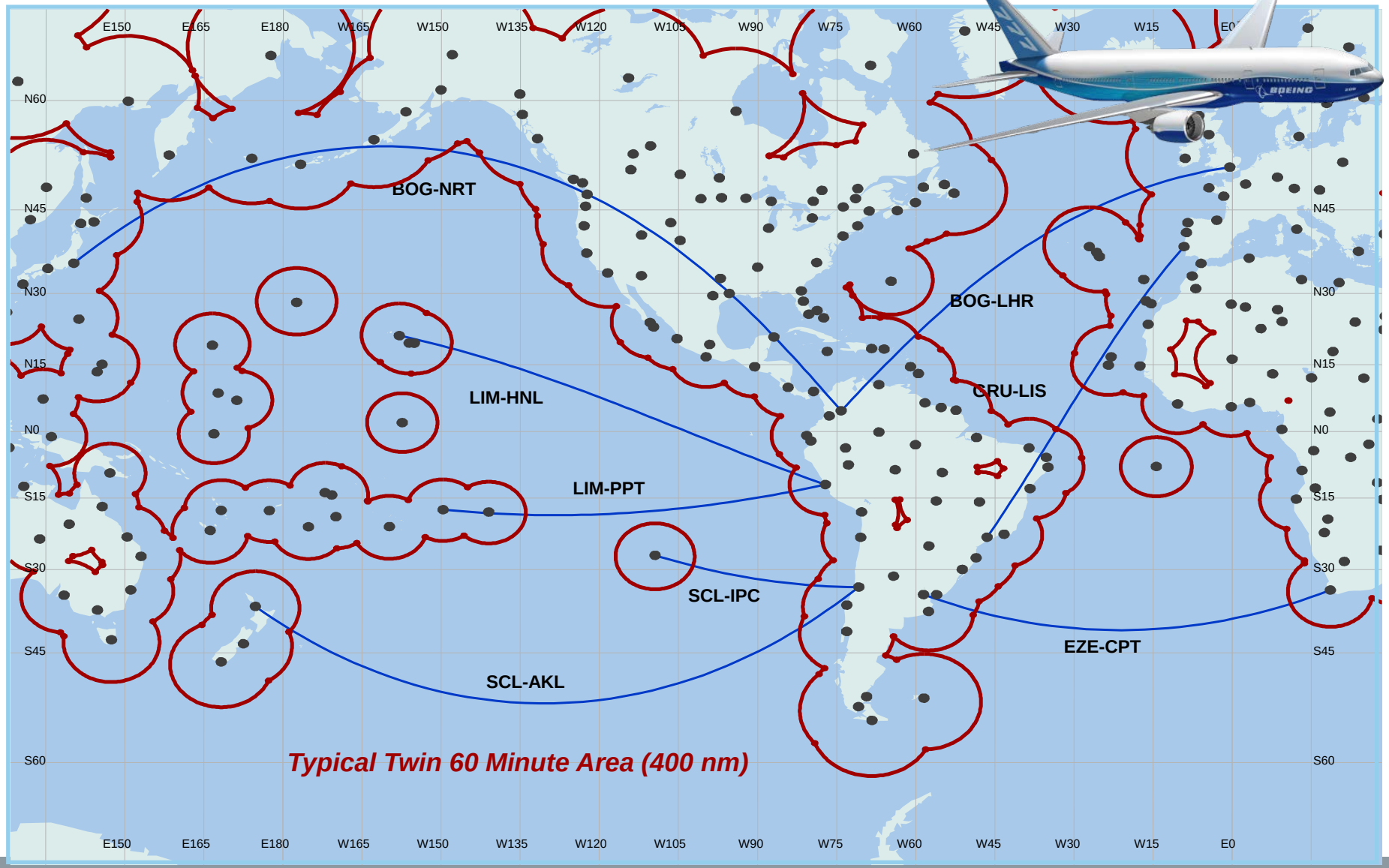
- Selection of Desired Routes
- Selection of adequate enroute alternate airports
- **Diversion Distance Determination**
  - **Diversion Time Required**
  - **Engine Inoperative Speed Selection**
  - **Reference Weight**
- Critical Fuel Estimates



*** May be an iterative process**

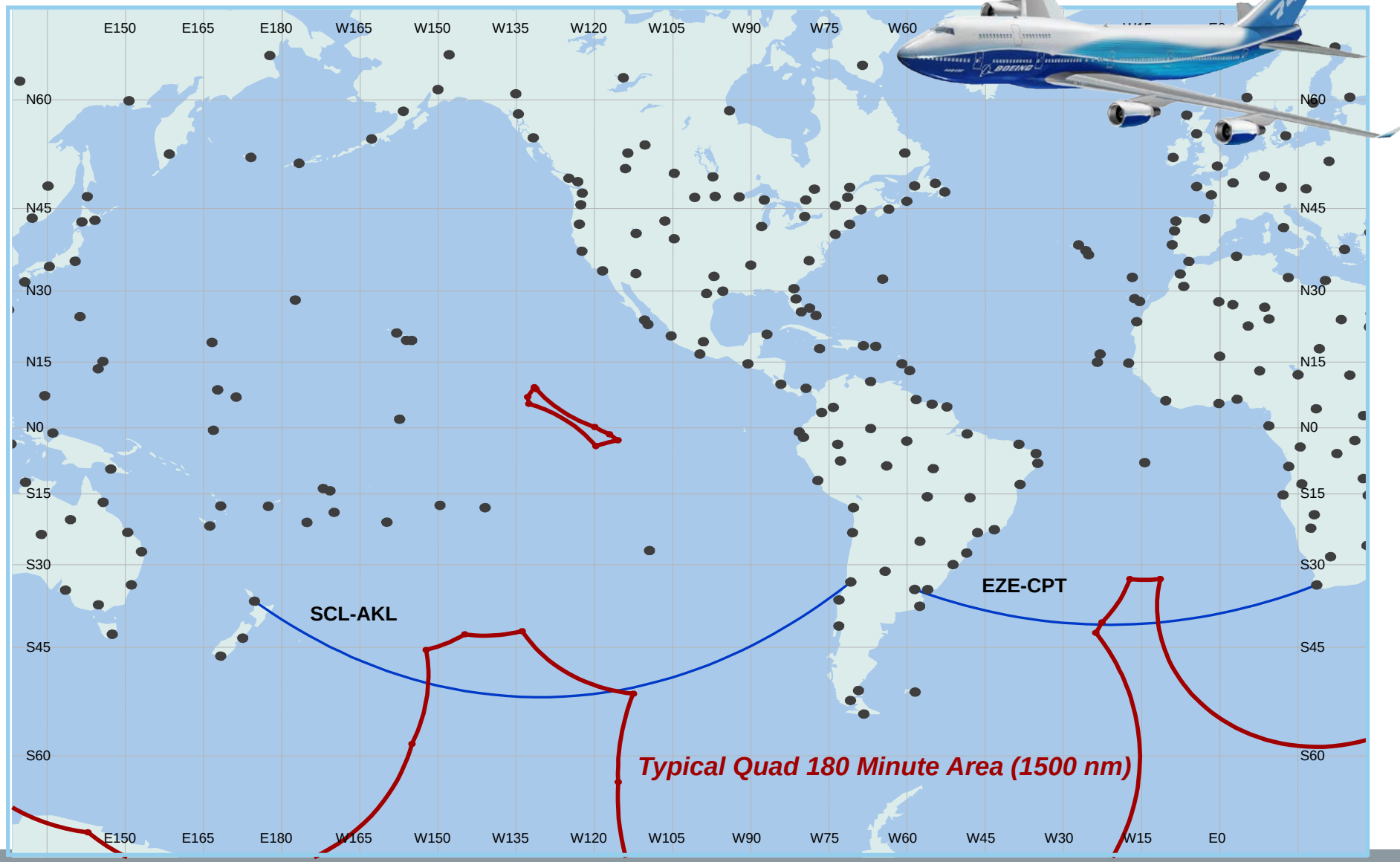
Potential Twin EDTO Routes

to/from South America



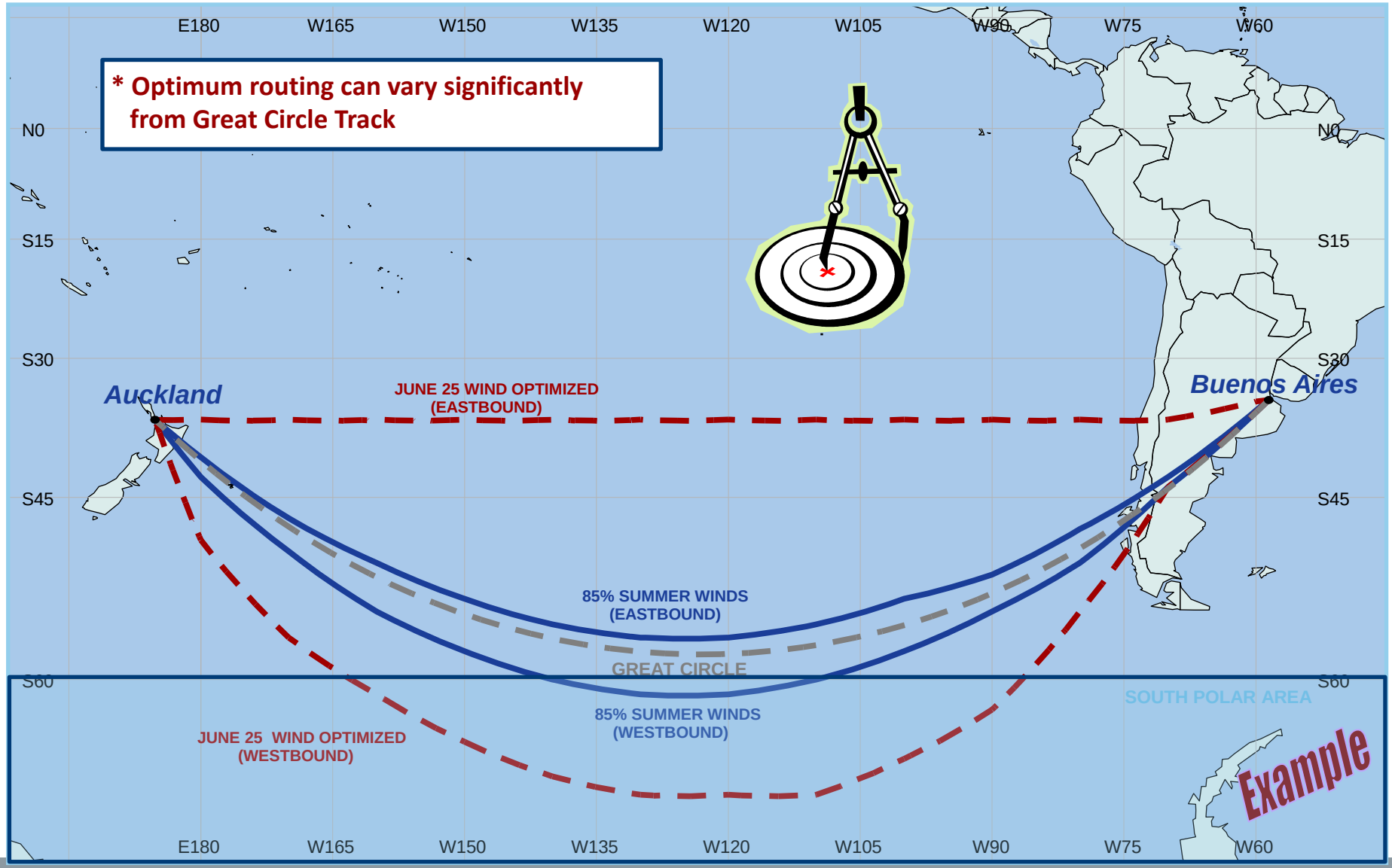
Potential Twin EDTO Routes

to/from South America (Cont)



EDTO Route Planning Example*

South Pacific



EDTO Definitions (FAR 121.7)

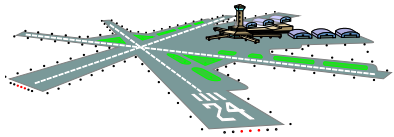
Adequate Airport

Initial Planning

- An airport that an airplane operator may list with approval from the FAA because that airport meets the landing limitations of 121.197 and is either
  1) An airport that meets the requirements of Part 139, Subpart D* of this chapter, excluding those that apply to aircraft rescue and firefighting service (RFFS), or
  2) A military airport that is active and operational

* Or equivalent requirements if outside U.S. jurisdiction

EDTO Alternate Airport*



- An *adequate airport* listed in the certificate holder's operations specifications that is designated in a dispatch or flight release for use in the event of a diversion during EDTO. This definition applies to flight planning and does not in any way limit the authority of the pilot-in command during flight

* **Meets adequate airport requirements *plus* RFFS and weather.**

Day to day Dispatch

Note: The term 'Suitable Airport' is no longer used for EDTO

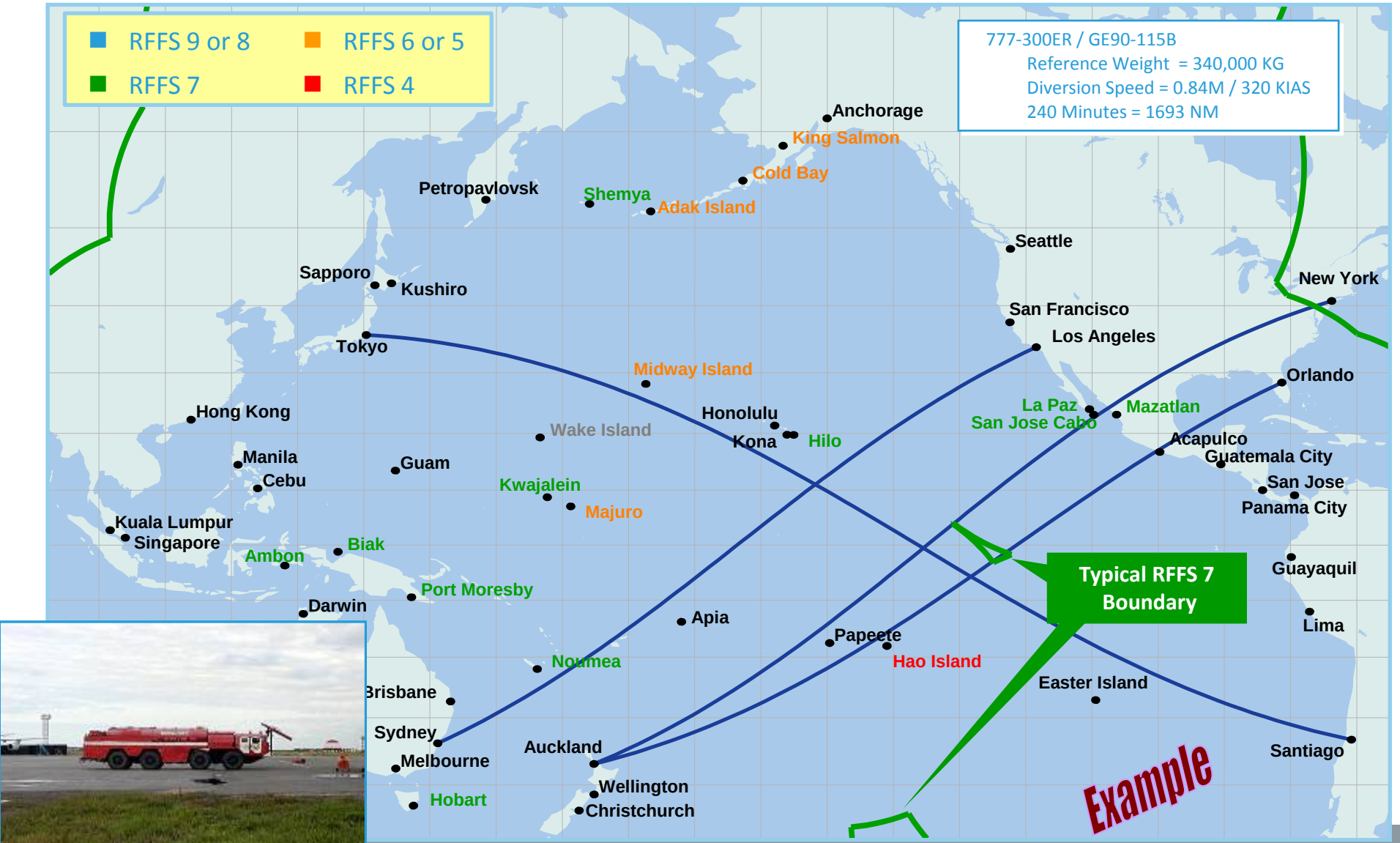
Rescue / Fire Fighting (RFFS) for En-route (EDTO) Alternate

FAA RFFS 7 Requirement for >180 minute EDTO does not apply to EASA

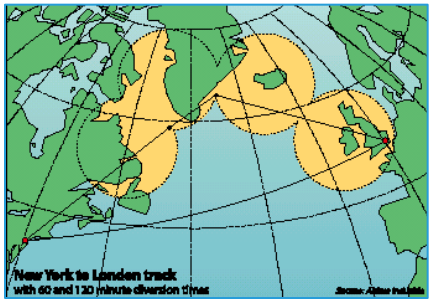
- ICAO RFFS Category 4 up to and including 180 minutes
  - For all EDTO per AMC 20-6
- RFFS Category 4 for operations beyond 180 minutes (including 207 minutes) plus RFFS 7 adequate airport area coverage for route
  - FAA
- Augmentation from local fire fighting assets with 30-minute response time if equipment not located at airport

Pacific Area of Operation RFFS

240-Minute EDTO



EDTO Definitions
(FAR 121.7)



EDTO Entry Point *

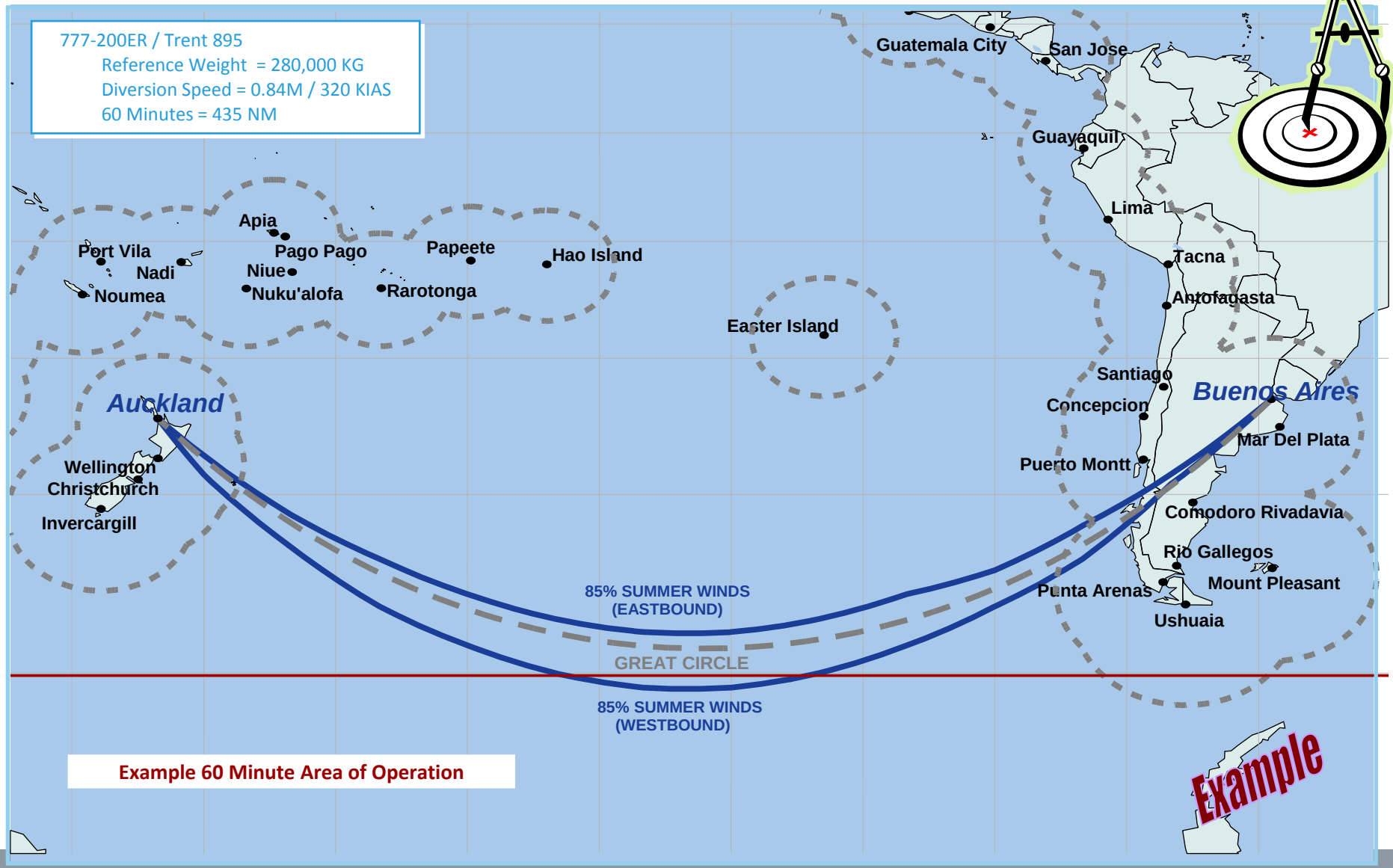
- The first point on the route of an EDTO flight, determined using a one-engine inoperative cruise speed under standard conditions in still air, that is

  1) More than 60 minutes from an adequate airport for airplanes with two engines;
  2) More than 180 minutes from an adequate airport for passenger-carrying airplanes with more than two engines

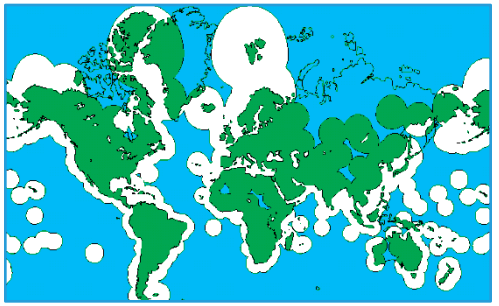
*The EDTO Exit Point is the last point in the route that exceeds the EDTO threshold

EDTO Route Planning Example

Establish 60 Minute Boundary



EDTO Definitions
(FAR 121.7)



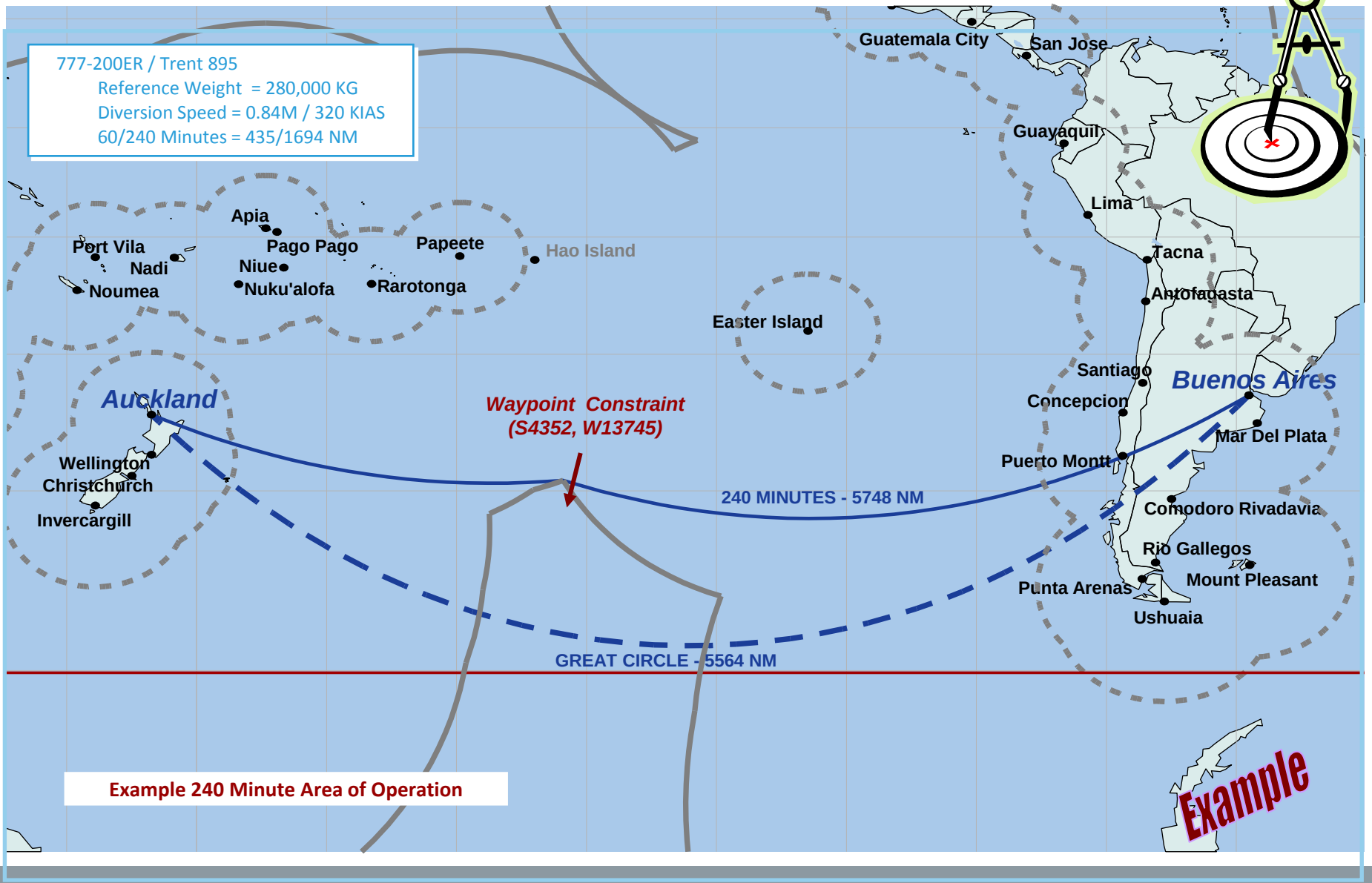
EDTO Area of Operation

1) For turbine-engine-powered airplanes with two engines, an area beyond ***60 minutes*** from an adequate airport, computed using a one-engine inoperative cruise speed under standard conditions in still air.

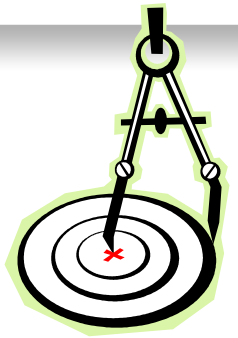
2) For turbine-engine-powered passenger-carrying airplanes with more than two engines, an area beyond ***180 minutes*** from an adequate airport, computed using a one-engine inoperative cruise speed under standard conditions in still air.

EDTO Route Planning Example

240 Minute EDTO Area



Evaluate Equal Time Points*



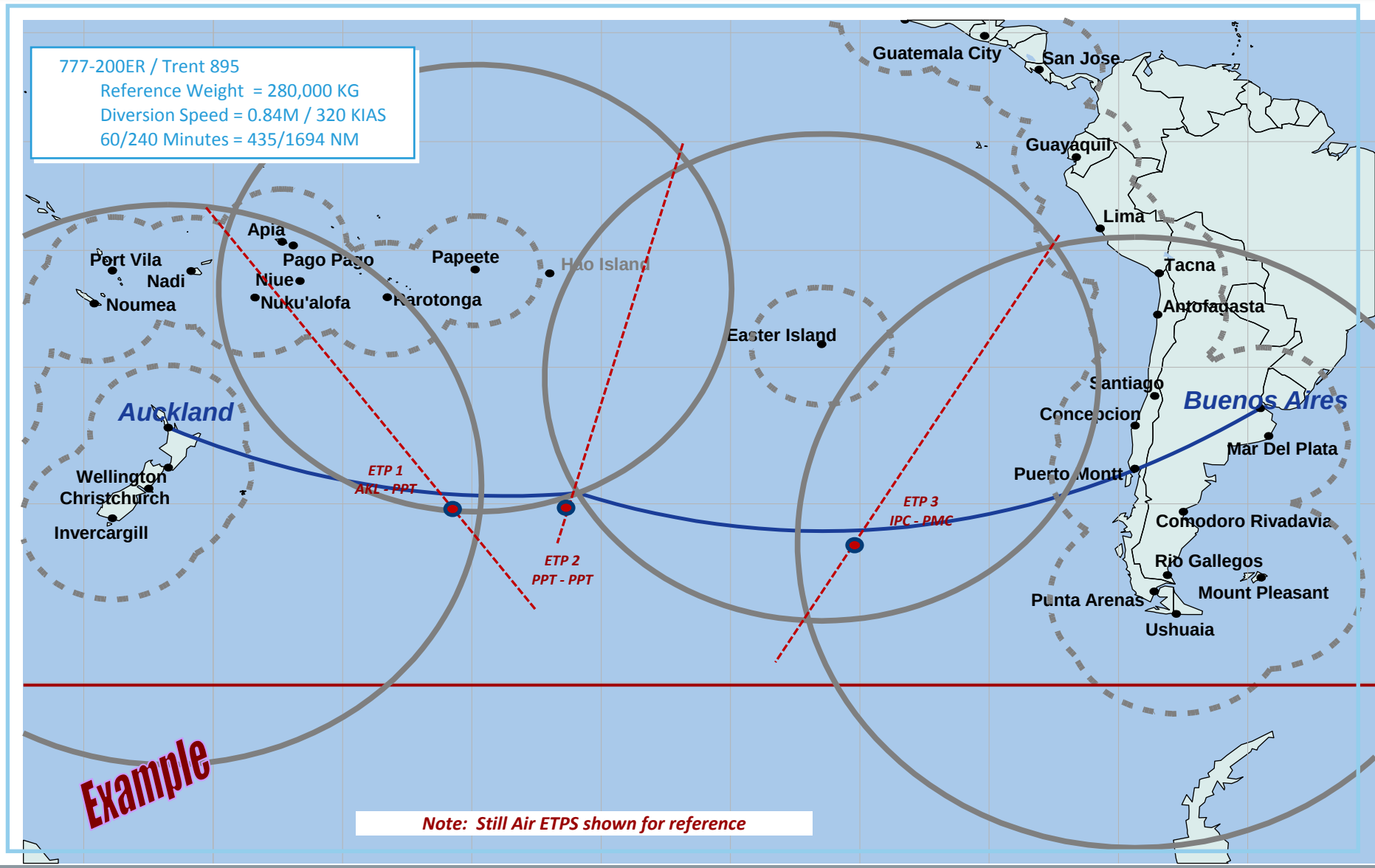
- The point of equal diversion time to EDTO alternates at the approved one engine inoperative cruise speed.
- Equal Time Points (ETPs) between alternates are typically determined from a computerized flight planning service using forecast weather conditions at decompression and engine inoperative cruise altitudes.
- Decompression ETPs may be used as the basis for all planning including Time Limited Systems

*** The *Critical Point* (CP) is the Equal Time Point at which the EDTO diversion fuel is closest to, or exceeds, the normal planned fuel on board**

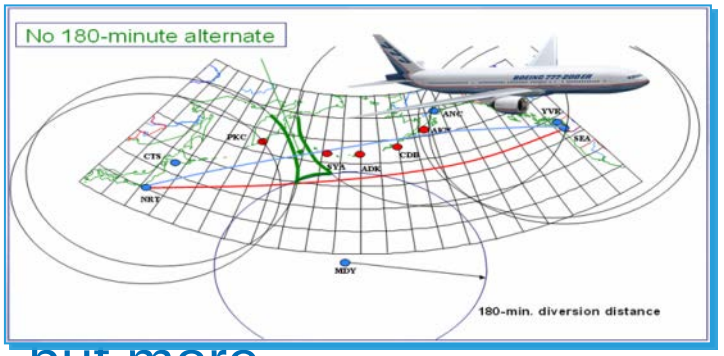
Adjust fuel load if required

EDTO Equal Time Points (ETPs)

AKL-EZE 240 Minutes



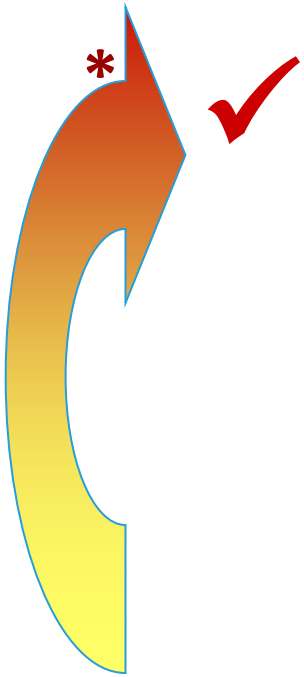
Considerations for
Higher Diversion Time Approval



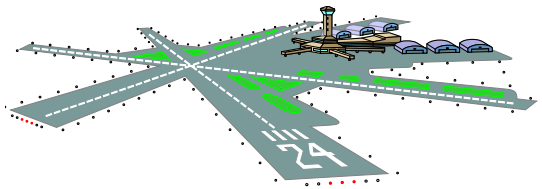
- Airplane is configured to a higher airworthiness standard
  - CMP, MMEL Compliance
- Fewer alternates required for dispatch, but more alternates available within EDTO diversion time capability
  - Allows selection of more favorable enroute alternates
- Mitigates potential for less direct ‘dog-leg’ routing and associated operational issues:
  - Increased route time increases potential for problems
  - Increased over water exposure
  - Reduced operating efficiency (time, fuel)

**** Higher diversion time approval improves both safety and dispatch flexibility***

Refine EDTO Planning Parameters



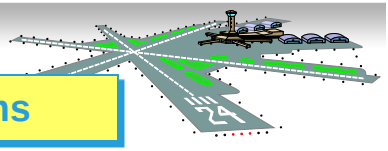
- Determine Diversion Distances from FPPM data or PET Analysis
  - Airframe/engine combination(s)
  - Engine inoperative speed
  - Reference weight
  - Diversion time required
- Finalize list of adequate alternate airports
  - Consider remote areas of route, EDTO entry/exit regions
  - Establish backup alternates to allow for airports unavailable at dispatch, potential routing variations



*** May be an iterative process**

En route (EDTO) Alternates

Published Data



Approach Minimums

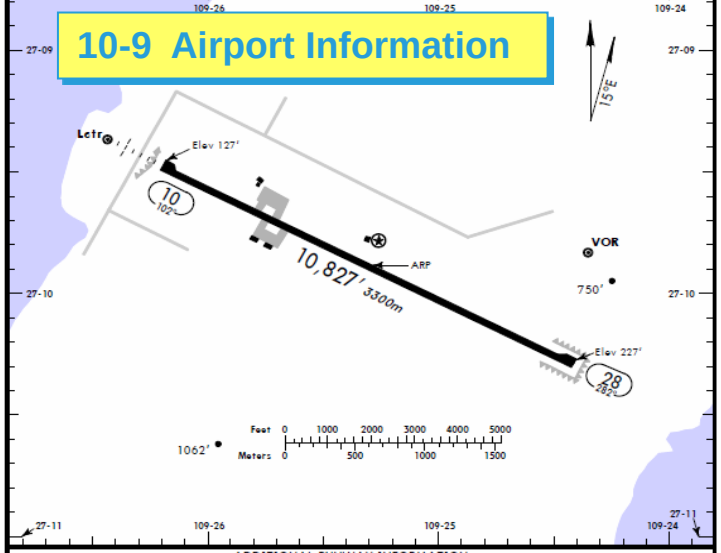
10-9 Airport Information

SCIP/IPC
Apt Elev 227′
S27 09.9 W109 25.3

JEPPESEN
12 APR 13 (10-9)

ISLA DE PASCUA, CHILE
MATAVERI INTL

PASCUA Ground 121.9X
Tower 118.1X



ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS LANDING Threshold	BEYOND Glide Slope	TAKE-OFF	WIDTH
10	HIRL SSALF PAPI-L (angle 2.50°)				148′ 45m
28	HIRL REIL PAPI-L (angle 2.80°)				

TAKE-OFF

	All Rwys
	Take-Off Alternate Apt. Not Filed
1 Eng 2 Eng 3 & 4 Eng	Available Landing Minimums

FOR FILING AS ALTERNATE

	ILS Y Rwy 10 ILS Rwy 10	VOR Rwy 10 VOR Y Rwy 28 VOR Z Rwy 28 NDB Z Rwy 10	NDB Z Rwy 28	NDB Y Rwy 10	NDB Y Rwy 28	Other
A B C D	600′-3.2 km	800′-3.2 km	893′-4.0 km	1113′-4.8 km	1193′-4.8 km	NA

CHANGES: Alternate minimums.

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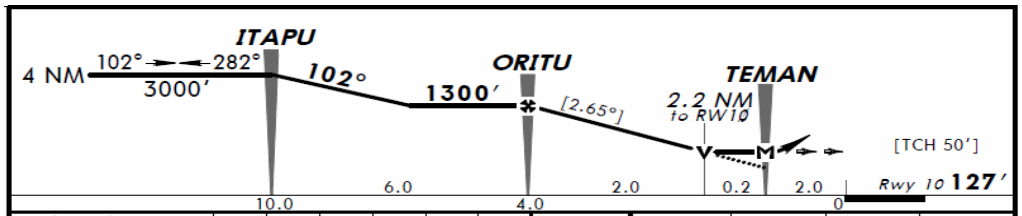


Gnd speed-Kts	70	90	100	120	140	160
Descent Angle [2.65°]	328	422	469	562	656	750
MAP at TEMAN						

SSALF
PAPI
3000′
D
ERUVI

STRAIGHT-IN LANDING RWY 10
LNAV
MDA(H) 800′(673′)

CIRCLE-TO-LAND

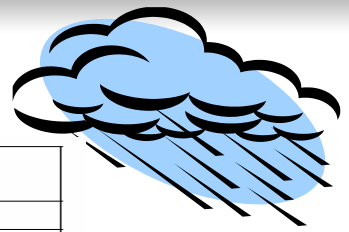
	ALS out	Max Kts	
A B	1.6 km	A B	
C	2.4 km	2.8 km	C
D	2.8 km	3.2 km	D

Index	Procedure ID
10-9	AIRPORT, AIRPORT INFO, TAKE-OFF MNMS
11-1	ILS RWY 10
11-2	ILS Y RWY 10
12-1	RNAV (GNSS) RWY 10
13-1	VOR RWY 10
13-2	VOR Y RWY 28
13-3	VOR Z RWY 28
16-1	NDB Y RWY 10
16-2	NDB Z RWY 10
16-3	NDB Y RWY 28
16-4	NDB Z RWY 28

Published Procedures

Weather Reliability Statistics

*Easter Island (IPC)**



	PROBABILIDAD PORCENTUAL (%) NUBOSIDAD MAYOR A 4 OCTAS Y ALTURA TECHO NUBES < A 1200 ft (370 m)							
	HORA UTC							
Mes	3:00	6:00	9:00	12:00	15:00	18:00	21:00	24:00
Ene	3.2	4.5	3.1	3.5	3.1	3.2	3.5	3.5
Feb	2.3	1.5	0.6	2.3	2.3	2.3	2.3	2.3
Mar	3.2	2.6	2.6	3.5	4.7	4.4	3.8	3.2
Abr	2.7	1.4	0.9	4.8	5.8	7.0	7.3	4.8
May	3.8	2.7	2.3	3.8	4.7	5.3	5.9	5.9
Jun	4.2	3.7	2.1	3.6	5.8	7.0	6.1	5.8
Jul	3.5	0.5	0.3	2.6	4.7	4.7	5.3	3.8
Ago	3.5	3.7	2.3	4.4	6.2	4.1	4.4	7.0
Sep	6.7	4.9	3.3	8.5	8.2	6.4	5.5	6.7
Oct	5.6	3.1	1.5	3.8	5.6	6.2	5.6	5.9
Nov	2.1	1.6	0.9	1.8	3.3	3.6	2.4	2.1
Dic	4.1	2.6	1.5	4.1	6.5	5.0	3.8	3.5

Periodo análisis: 1988-1998

	PROBABILIDAD PORCENTUAL (%) DE VISIBILIDAD MENOR A 4600 m							
	HORA UTC							
Mes	3:00	6:00	9:00	12:00	15:00	18:00	21:00	24:00
Ene	0.2	0.0	2.1	0.2	0.6	1.0	0.2	0.8
Feb	0.4	0.0	0.0	0.2	0.4	0.7	0.9	0.2
Mar	0.2	0.6	0.6	0.4	0.4	0.6	1.4	0.6
Abr	1.3	0.0	0.0	1.0	0.8	1.7	1.5	2.3
May	1.0	0.6	1.2	1.2	2.4	1.8	2.0	1.4
Jun	0.6	0.0	2.0	0.8	2.3	1.9	0.8	2.3
Jul	0.8	0.0	0.0	3.4	3.0	2.4	2.2	1.2
Ago	0.6	0.0	0.0	1.0	2.4	1.0	1.2	1.2
Sep	1.5	1.3	0.6	1.7	2.1	2.1	2.1	1.9
Oct	1.2	0.0	0.0	1.2	1.4	0.8	1.2	0.4
Nov	1.5	0.8	1.5	2.5	1.7	2.1	2.3	1.0
Dic	0.0	0.0	0.0	1.0	1.2	0.8	0.6	1.2

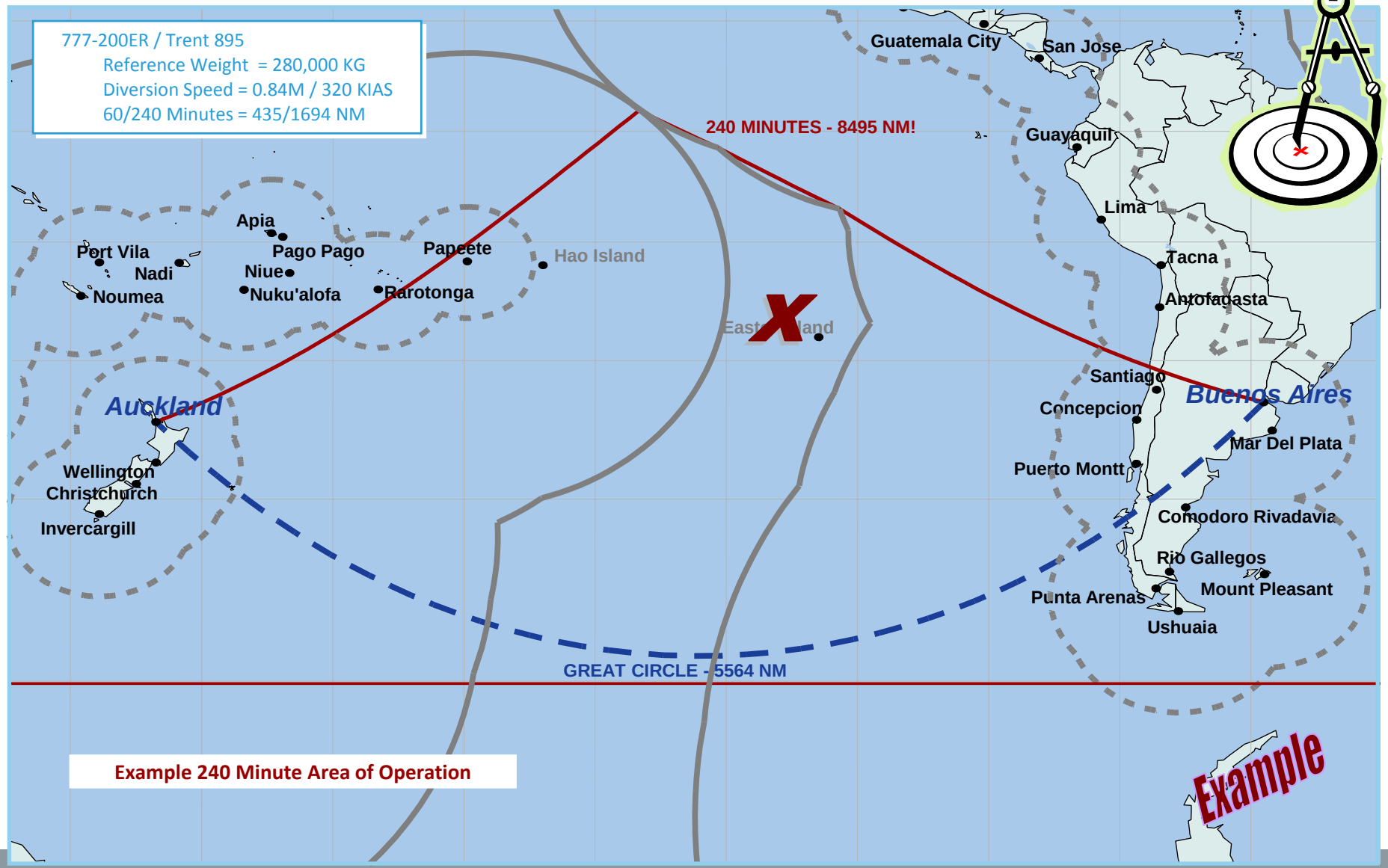
Periodo análisis: 1990-2005

Example

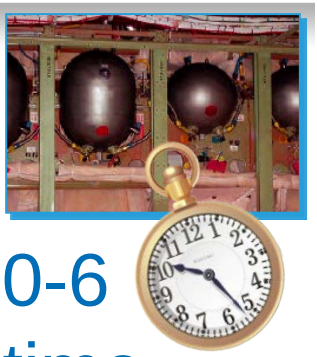
*** IPC is also unavailable when LAN flights from Santiago are committed to land**

EDTO Route Planning Example

240 Minute EDTO Area - Without IPC



EDTO/EDTO Beyond 180 Minutes



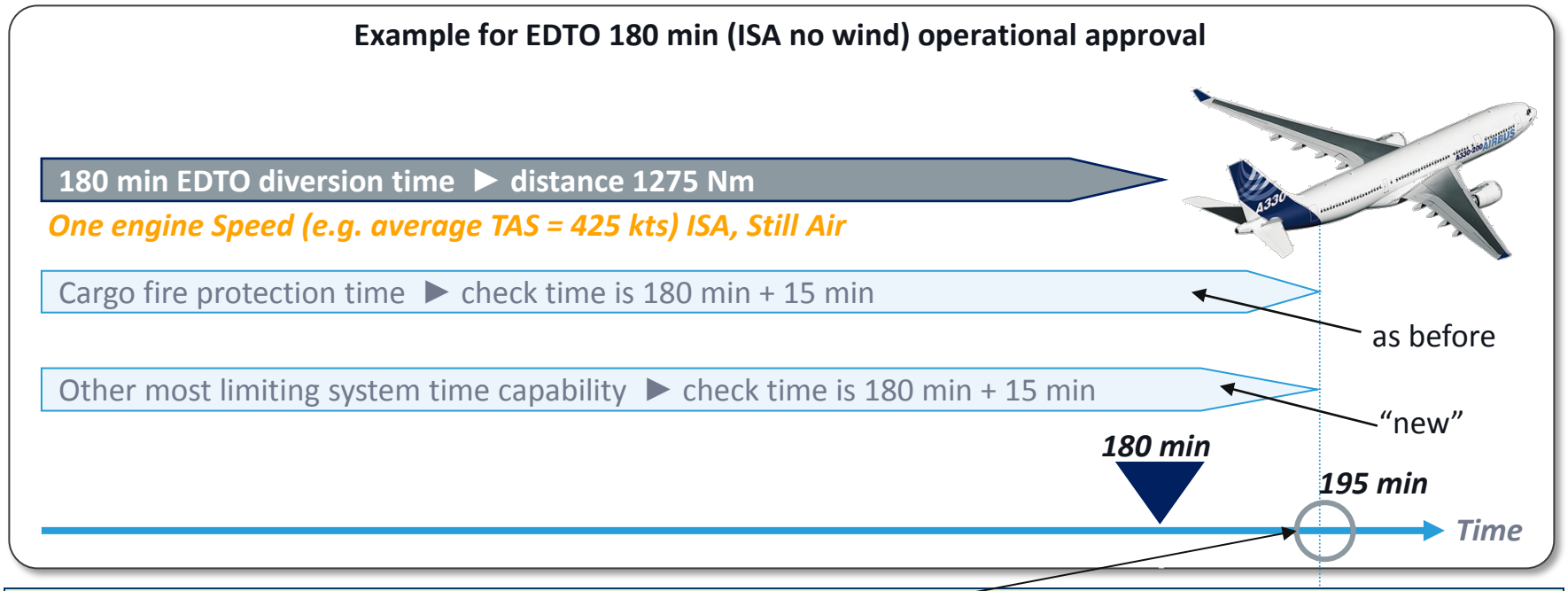
- Additional requirements defined by FAR 121.633(b) and Chapter 3 Sec. 7.2.3 AMC 20-6
- Allowed routing must also consider airplane time limited system capability corrected for forecast wind and temperature
  - All engine cruise speed for cargo fire suppression time capability minus 15 minutes
  - Engine inoperative cruise speed for other EDTO significant system time capability minus 15 minutes.
- For 240 minute EDTO, time limited system planning is in addition to still air EDTO area (maximum diversion time).
  - For EDTO ‘beyond 240 minutes’, still air EDTO area is not applicable as there is no specific maximum diversion time.

Time Limited System

EDTO up to 180 min

Consideration of Time Limited Systems at dispatch
For EDTO **up to 180 min**: consider **ISA /Still Air conditions**

Example for EDTO 180 min (ISA no wind) operational approval



1. Check at dispatch that these values do not exceed corresponding Time Limited system(s) capabilities
2. If one or both values are reduced (e.g. in case of MMEL) ► Select another route within the corrected Time Limited system(s) capabilities

Manufacturer has to identify the time limited system(s) capabilities and to include the corresponding values in the AFM and EDTO / ETOPS CMP Document

Time Limited System

EDTO beyond 180 min

Consideration of Time Limited Systems at dispatch
For EDTO **>180 min**: consider **forecast wind and temperature**

Example for EDTO 240 min (ISA no wind) operational approval

240 min EDTO diversion time ► distance 1700Nm

One engine Speed (e.g. average TAS = 425 kts) ISA, Still Air

Cargo fire protection time ► check time to cover 1700Nm

All engines Speed, Actual weather conditions, incl. 15min margin

Other most limiting system time capability ► check time to cover 1700Nm

One engine Speed, Actual weather conditions, incl. 15min margin

**= time values provided as examples*

240 min

231 min*

263 min*

Time

1. Check at dispatch that these values do not exceed corresponding Time Limited system(s) capabilities
2. If one or both values are reduced (e.g. in case of MMEL) ► Select another route within the corrected Time Limited system(s) capabilities

Manufacturer has to identify the time limited system(s) capabilities and to include the corresponding values in the AFM and EDTO / ETOPS CMP Document

The time capability of the cargo fire suppression system is 260 min.
The time capability of all the other ETOPS significant systems is 300 min.
The maximum diversion distance is 1 700 nm.

EDTO beyond 180/207 Minute Compliance

*777-200ER AFM Appendix 6**

BOEING 777 AIRPLANE FLIGHT MANUAL

EXTENDED OPERATIONS (EDTO)

The type-design reliability and performance of this airplane/engine combination has been evaluated under 14 CFR 25.1535 and found suitable for beyond 180 minutes extended operations (EDTO) configured in accordance with Boeing Document D044W054 "MODEL 777 EDTO Configuration, Maintenance, and Procedures". The actual maximum approved diversion time for this airplane may be less based on its most limiting system time capability. This finding does not constitute approval to conduct EDTO.

Determine the configuration of the airplane prior to the use of the following system time capabilities:

System Time Capabilities:

The most limiting EDTO significant system time (other than cargo fire suppression) is 345 minutes.

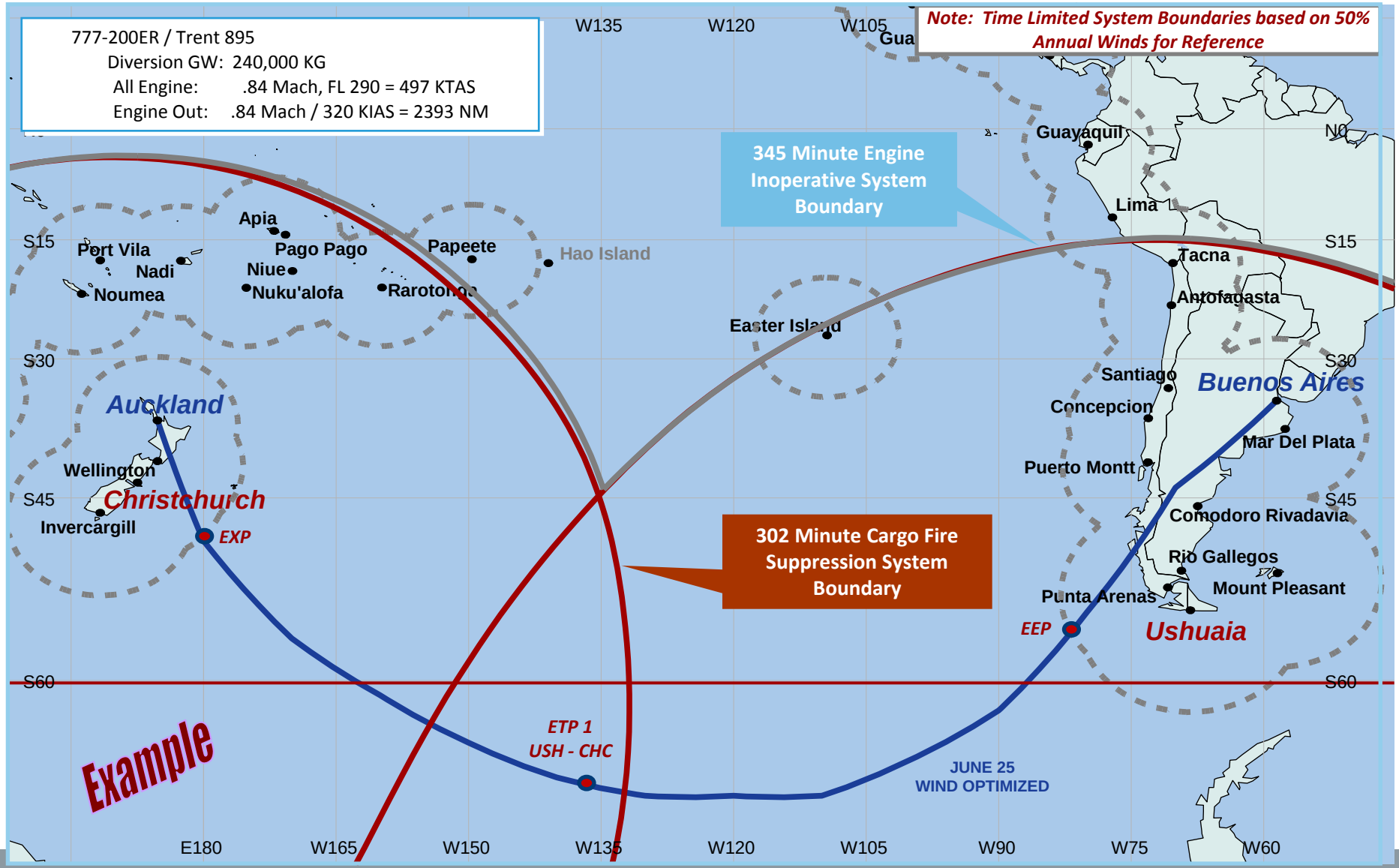
The most limiting cargo fire suppression system time is *302 minutes.*

Example

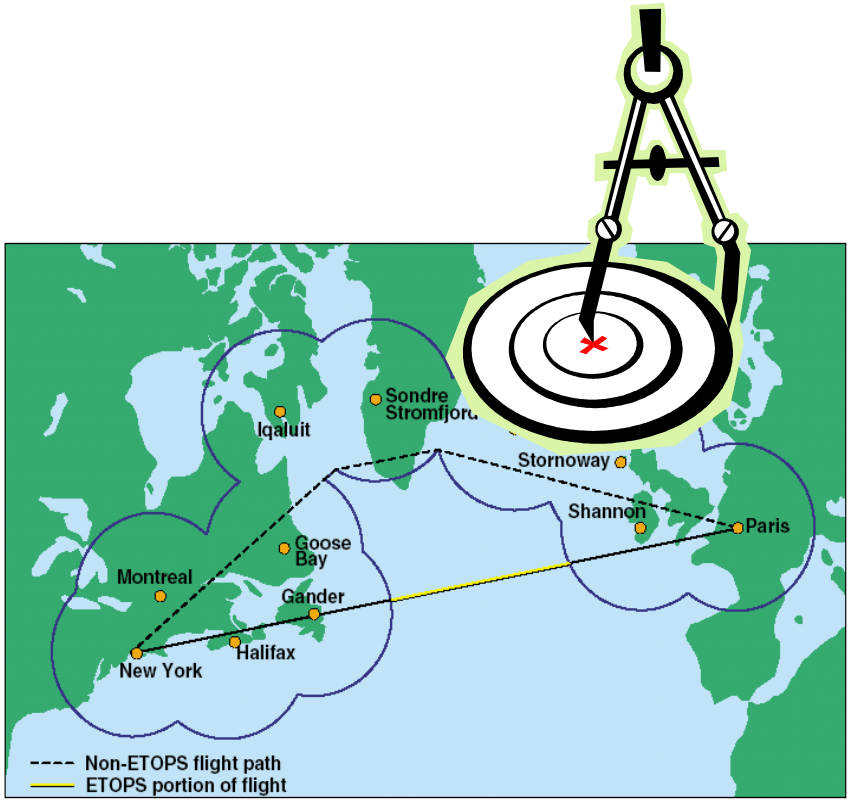
**** 777-200ER Maximum Cargo Fire Suppression time is 272 minutes***
(a 302 minute system option is subject to certification)

EDTO Flight Plan Example

EZE - AKL, 330 Minutes

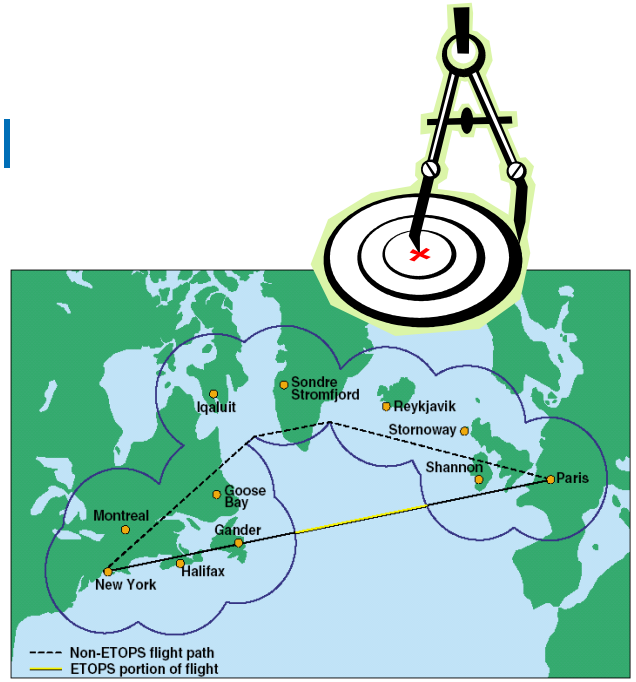


EDTO Dispatch Planning



EDTO Dispatch Planning

- Review forecast weather and NOTAMs to determine EDTO alternates from airline's approved list
- Establish allowed area of operation based on EDTO alternates available
- Compute Equal Time Points and critical fuel requirements based on forecast winds
- Evaluate MEL implications, as required
- Produce EDTO Flight Plan

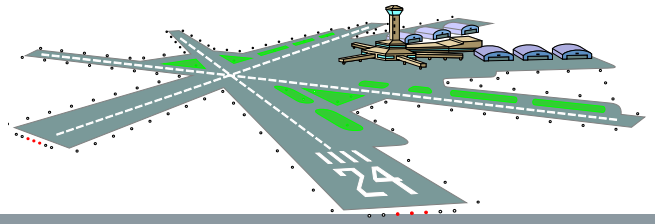


En route (EDTO) Alternate Aerodrome

Weather Minimums

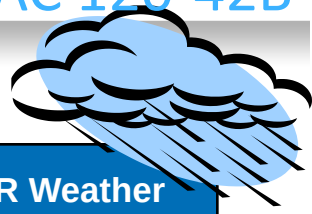
Requirements

- Must be at or above authorized minimums for dispatch
  (FAR 121.624, 121.625 and EU-OPS 1.297)
  - Weather reports and/or forecasts should be available
  - Validity period based on earliest to latest (FAA) or one hour after latest (EASA) expected arrival times
    - Some relief from previous practice
- AC 120-42B and AMC 20-6 provide additional guidance
  - Non precision and Cat I approaches
  - Authorized Cat II/III approaches
  - GPS/RNAV Approaches *(FAA)*
  - Conditional forecast elements



En route (EDTO) Alternate Dispatch

Weather Minima* AC 120-42B



Approach Facility Configuration [1]	Alternate Airport IFR Weather Minimum Ceiling [2]	Alternate Airport IFR Weather Minimum Visibility [2]
For airports with at least one operational navigational facility providing a straight–in non-precision approach procedure, or Category I precision approach, or, when applicable, a circling maneuver from an instrument approach procedure.	Add 400 ft to the MDA or DH as applicable.	Add 1 sm or 1600m to the landing minimum.
For airports with at least two operational navigational facilities, each providing a straight-in approach procedure to different suitable runways.	Add 200 ft to the higher DH or MDA of the two approaches used.	Add ½ sm or 800 m [4] to the higher authorized landing minimum of the two approaches used.
One useable authorized Category II ILS IAP.	300 feet	3/4 sm (1200 m) or RVR 4000 (1200 m)
One useable authorized category III ILS Instrument Approach Procedure (IAP).	200 feet	1/2 sm (800 m) [4] or RVR 1800 feet (550 m)

Separate runway surfaces no longer required

- **Dispatch check is from <u>earliest to latest expected arrival times</u>**
- **Once airborne, normal operating minima apply up to ETOPS entry (EEP)**

En route (EDTO) Alternate Aerodrome
Weather Minima

AMC 20-6 Appendix 5 and EU-OPS 1.297

2. DISPATCH MINIMA – EN-ROUTE ALTERNATE AERODROMES

An aerodrome may be nominated as an ETOPS en-route alternate for flight planning and release purposes if the available forecast weather conditions for a period commencing at the earliest potential time of landing and ending one hour after the latest nominated time of use of that aerodrome, equal or exceed the criteria required by Table 1 below.

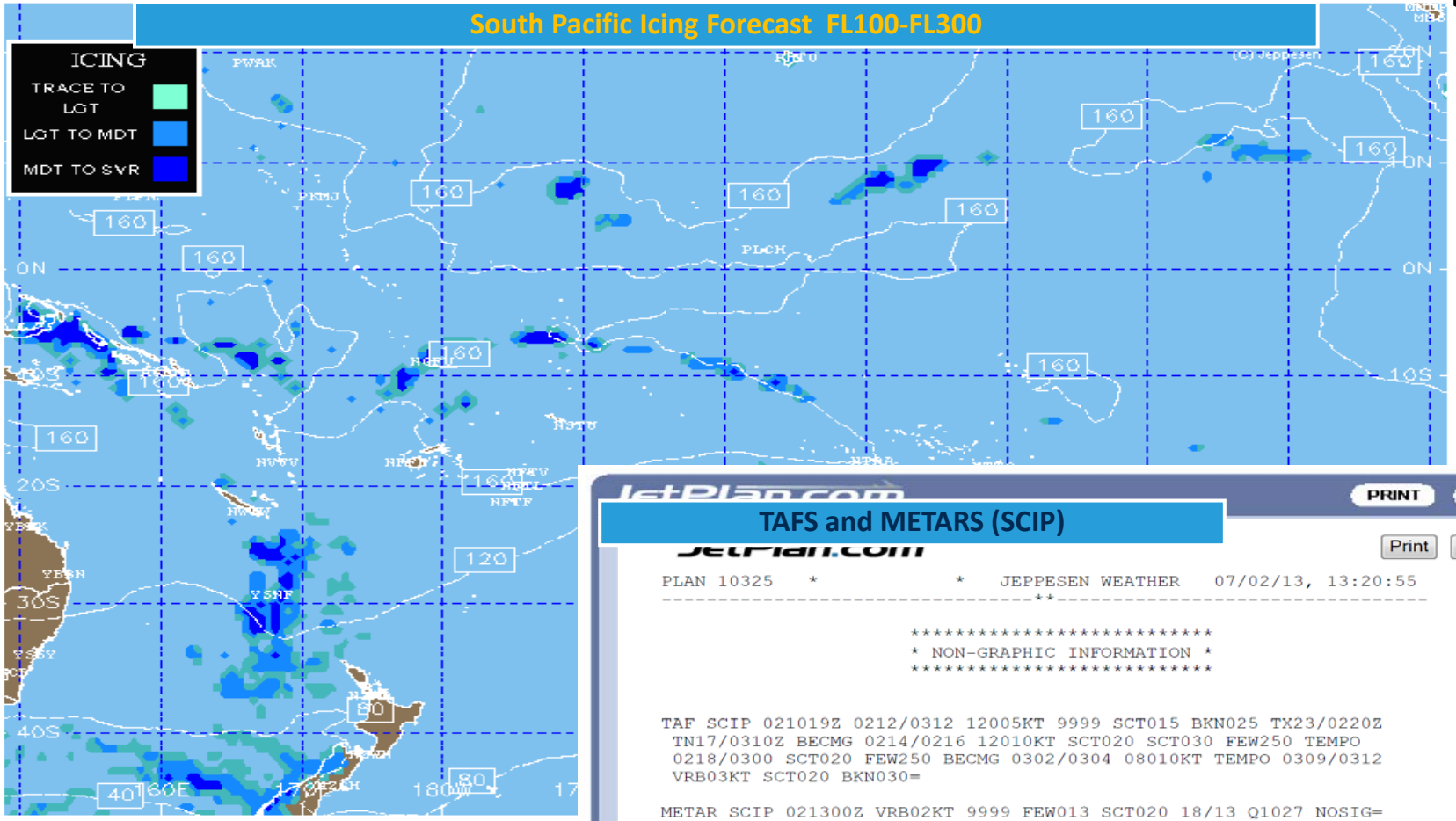
Table 1. Planning Minima

Approach Facility	Ceiling	Visibility
Precision Approach	Authorised DH/DA plus an increment of 200 ft	Authorised visibility plus an increment of 800 metres
Non-Precision Approach or Circling approach	Authorised MDH/MDA plus an increment of 400 ft	Authorised visibility plus an increment of 1500 metres

- The above criteria for precision approaches are only to be applied to Category 1 approaches. *
- When determining the usability of an Instrument Approach (IAP), forecast wind plus any gusts should be within operating limits, and within the operators maximum crosswind limitations taking into account the runway condition (dry, wet or contaminated) plus any reduced visibility limits.
- Conditional forecast elements need not be considered, except that a PROB 40 or TEMPO condition below the lowest applicable operating minima should be taken into account.
- When dispatching under the provisions of the MEL, those MEL limitations affecting instrument approach minima should be considered in determining EDTO alternate minima.

**** relief for advanced landing systems (Cat II/III) may also be approved***

EDTO Weather Information



TAFS and METARS (SCIP)

PRINT CLOSE

Print Close

```
PLAN 10325    *              *    JEPPESEN WEATHER    07/02/13, 13:20:55
---------------------------------**---------------------------------

                          ****************************
                          * NON-GRAPHIC INFORMATION *
                          ****************************


TAF SCIP 021019Z 0212/0312 12005KT 9999 SCT015 BKN025 TX23/0220Z
 TN17/0310Z BECMG 0214/0216 12010KT SCT020 SCT030 FEW250 TEMPO
 0218/0300 SCT020 FEW250 BECMG 0302/0304 08010KT TEMPO 0309/0312
 VRB03KT SCT020 BKN030=

METAR SCIP 021300Z VRB02KT 9999 FEW013 SCT020 18/13 Q1027 NOSIG=
SCIP 021200Z 12004KT 9999 FEW013 SCT020 18/14 Q1027 NOSIG=
SCIP 021100Z 12005KT 9999 FEW013 SCT020 19/14 Q1027 NOSIG=


END 0004 WEATHER/NOTAM REPORTS 000 GRAPHIC 004 NON-GRAPHIC 000 NOTAM
---------------------------------**---------------------------------

END OF JEPPESEN DATAPLAN REQUEST NO. 10325
```

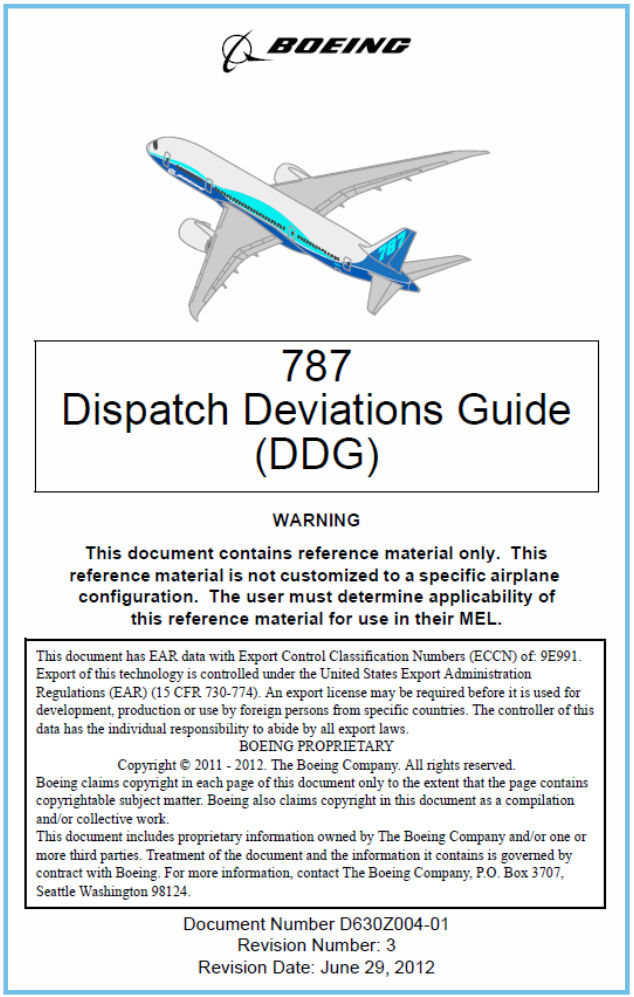
Extracted from Jeppesen Weather Services (www.jetplan.com)

MMEL, DDG, MEL

- Master Minimum Equipment List *(MMEL)*
  - FAA Document maintained by airplane model
  - Contains all approved deviations for inoperative equipment
- Minimum Equipment List *(MEL)*
  - Airline document required by FAR 121.628 and EU-OPS 1.030
  - Can not be less restrictive than MMEL
- Dispatch Deviations Guide *(DDG)*
  - Boeing *advisory* document to assist operator interpretation of MMEL
  - Contains expanded operational ***(O)*** and maintenance ***(M)*** procedures
  - Also includes approved Configuration Deviation List *(CDL)*

EDTO Dispatch Deviations
Continued

- Certain MMEL/DDG items have unique dispatch requirements for EDTO flights.
  - EDTO items are denoted as either ***'ER'*** or by a ***diversion time limit***
- **'ER':** Refers to extended operations of an airplane which has a type design approval for EDTO
  - This term is used in all applicable MMELs except the 777 and 787
- The 777 and 787 MMEL use a diversion time limit instead of the term 'ER' to denote EDTO dispatch requirements


BOEING

787
Dispatch Deviations Guide
(DDG)

WARNING

This document contains reference material only. This reference material is not customized to a specific airplane configuration. The user must determine applicability of this reference material for use in their MEL.

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Document Number D630Z004-01
Revision Number: 3
Revision Date: June 29, 2012

737 Example: APU Generator (ATA 24)

BOEING

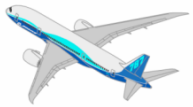
ATA 24 **737 Dispatch Deviations Guide** **Section 2**

24-02 APU Generator System

Interval	Installed	Required	Procedure
C	1	0	

Except for ER operations, may be inoperative.

787 Example: Auxiliary Power Unit



787
Dispatch Deviations Guide
(DDG)

BOEING

Section 2 **787 Dispatch Deviations Guide** **ATA 49**

49-11-01 Auxiliary Power Unit (APU)

Interval	Installed	Required	Procedure
C	1	0	**(O)**

May be inoperative provided:

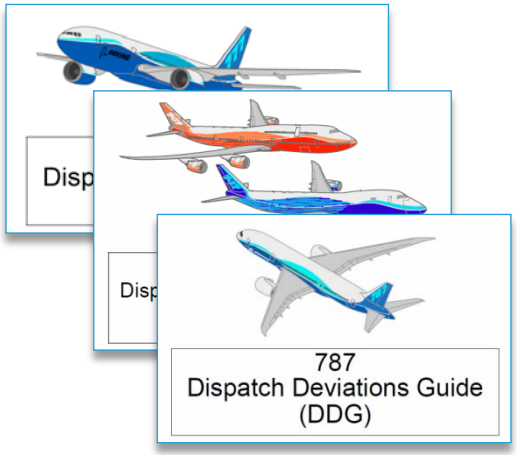
a. VFSG systems operate normally.

b. Flight remains within 180 minutes of landing at a suitable airport.

EDTO Dispatch Requirements

*Beyond 180 Minute Diversion Time Considerations **

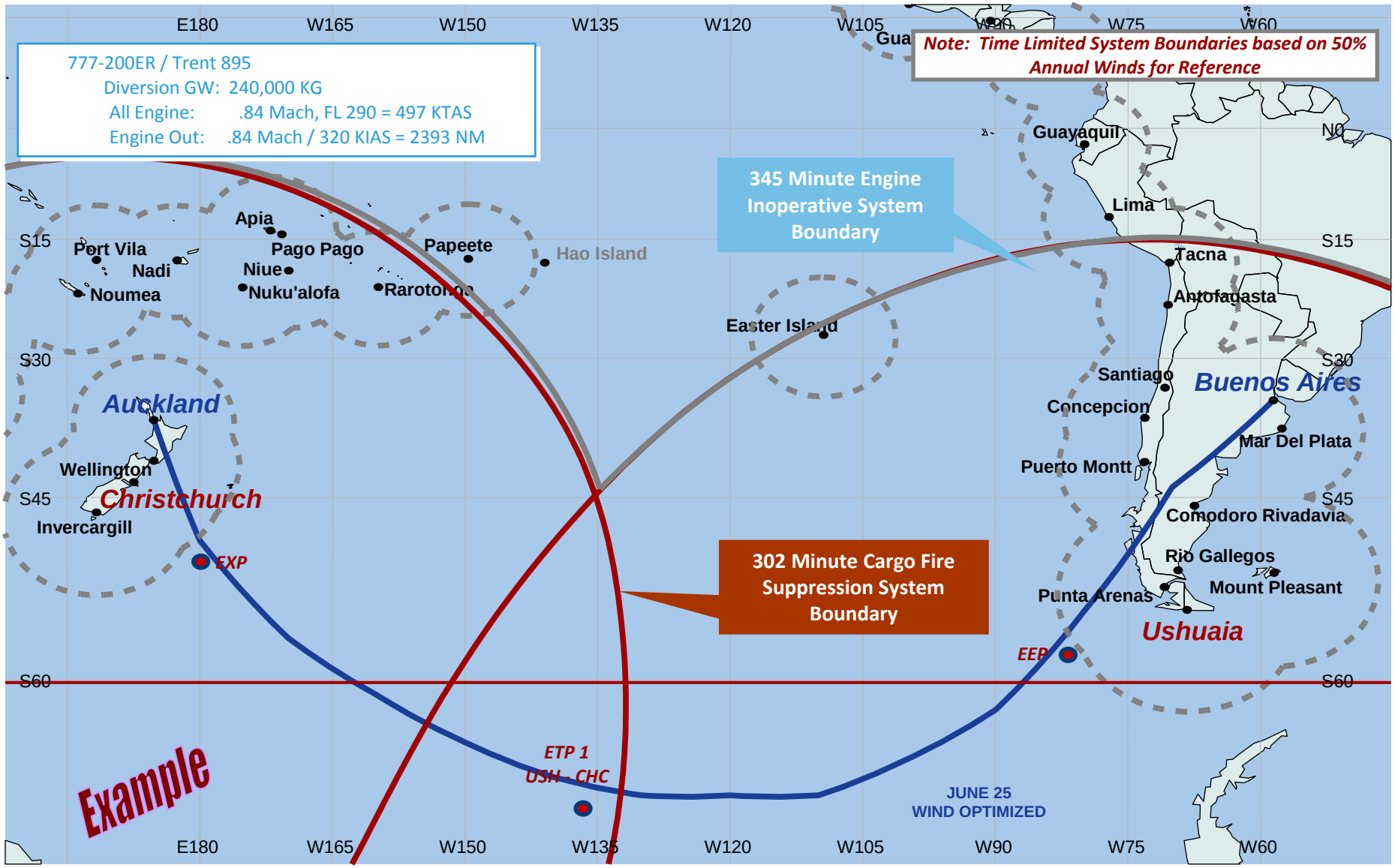
- FAR Part 121, Appendix P and Policy Letter 40
  - Fuel Quantity Indicating System (FQIS)
  - APU, both electrical and pneumatic
  - Auto throttle system
  - Second communication system (SATCOM Voice)
  - Engine-out auto-land *(if used for planning)*
- EASA AMC 20-6, Appendix 4
  - Fuel Quantity Indicating System (FQIS)
  - APU, both electrical and pneumatic
  - Automatic engine or propeller control system
  - Communication system(s) relied on by the flight crew to comply with communication requirements



**** Requirements included in affected MMEL/DDG Documents***

EDTO Flight Plan Example

EZE - AKL, 330 Minutes



EDTO Flight Plan Example

Boeing 'FLE' Format

Fuel Summary - FAR International Reserves

```
///// THIS FLIGHT PLAN COMPLIES WITH THE 330 MIN EDTO RULE /////

PLAN 0331 06252046Z       FOR  ETD 1900Z
FLT REL IFR         /26  SAEZ/EZE TO NZAA/AKL MACH: M84 REGN 772895
PROGS 2512NWS        ELEV 0067FT     0023FT AVG W/C P003 ISA DEV M06
COMP 2046Z FOR ETD 1900Z/26JUN13  REGN 772895  777-200  TRENT895 LBS

SUBJECT TO THE FOLLOWING CONDITIONS
EDTO FLIGHT/MAX DIVERSION TIME IN STILL AIR LIMITED TO 330 MINUTES
FROM THE FOLLOWING EDTO ALTERNATE AIRPORTS - SAWH/USH
                                             NZCH/CHC

            FUEL TIME    CORR  OWE  322191 PYLD 102549 APLD .. .. ..
DEST NZAA 200689 12+13 . . . . EZFW 424740 MZFW 440000 AZFW .. .. ..
RESV       16869 01+13 . . . . ETOW 660000 MTOW 660000 ATOW .. .. ..
DEST-MNVR      0 00+00 . . . . ELDW 459311 MLDW 470000 ALDW .. .. ..
ALTERNATE  11126 00+45 . . . . NZWN FL330  0259 NM  M.77   W/C P026
HOLD-ALT    6576 00+30 . . . .
EDTO ADD       0 00+00
REQD      235260 14+41 . . . . NOTE - LDGWT INCLUDES RESERVE FUEL
EXTRA     000000 00+00 . . . . NOTE - APM  0000   PCN
TAXI        1000                SCHEDULE TIMES ETD 1900/.. .. .. ..
TOTAL     236260 14+41 . . . .  RTE            ETA 0713/.. .. .. ..

INCREMENTAL BURN PER 1000 LBS INCREASE/DECREASE IN TOW: 294

ATC CLRNC:.. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. ..
-M084F320 DCT 44S070W/M084F340 55S080W 62S090W 65S100W 67S110W
 67S120W 67S130W 66S140W 64S150W/M084F360 61S160W 57S170W 49S180W
 DCT
FL  320/4470W 340/64W50 360
```

Identifies type of plan

Dispatch Limitation

Critical Fuel Uplift (if any)

10% Trip Time Contingency

EDTO Flight Plan Example

Boeing 'FLE' Format (Cont)

Diversion Fuel Buildup

```
------- EQUAL TIME POINT DATA - ETP01 SAWH/USH - NZCH/CHC --------

DIVERSION SUMMARY
ETP LOCATION          S6626.4 W13625.8
ETE FROM ORIGIN       06+53
GWT AT DIVERSION      532058
FOB                   07318
DIVERSION AIRPORTS          SAWH/USH          |          NZCH/CHC
G/C DIST                    2013              |          2142

CRITICAL FUEL REQUIRED CALCULATION
FLIGHT CONDITION      DECOMP DECOMP PRESS   |  DECOMP DECOMP PRESS
CONFIG                2 ENG  1 ENG  1 ENG   |  2 ENG  1 ENG  1 ENG
SPEED                 LRC    320    320     |  LRC    320    320
FL                    100    100    200     |  100    100    200
AVG W/C               M003   M003   M009    |  P019   P019   P034
ENROUTE TEMP          M028   M028   M045    |  M017   M017   M037
FORECAST ICING PCT    000100 000100 000100  |  000100 000100 000100
TIME TO ALT NO HOLD   05+54  05+49  05+06    |  05+51  05+43  04+50
CRUISE                089650 090118 079048  |  090765 090436 076941
DESCENT               000627 000657 000780  |  000627 000657 000780
HOLD                  003247 003019 003089  |  003239 003017 003103
APU                   000000 002854 002779  |  000000 002802 002646
ICING                 003611 000908 001597  |  003656 000911 001554
TOTAL                 097135 097556 087293  |  098287 097823 085024
```

ETP 1 is the Critical Point for this flight

EDTO Engine out Speed determined by airline policy

Diversion Time is based on Forecast Winds and may exceed EDTO Time

Agenda

- Defining the EDTO area of operations
- Performing EDTO Flight Planning
- Conducting EDTO Flights
- Conclusions

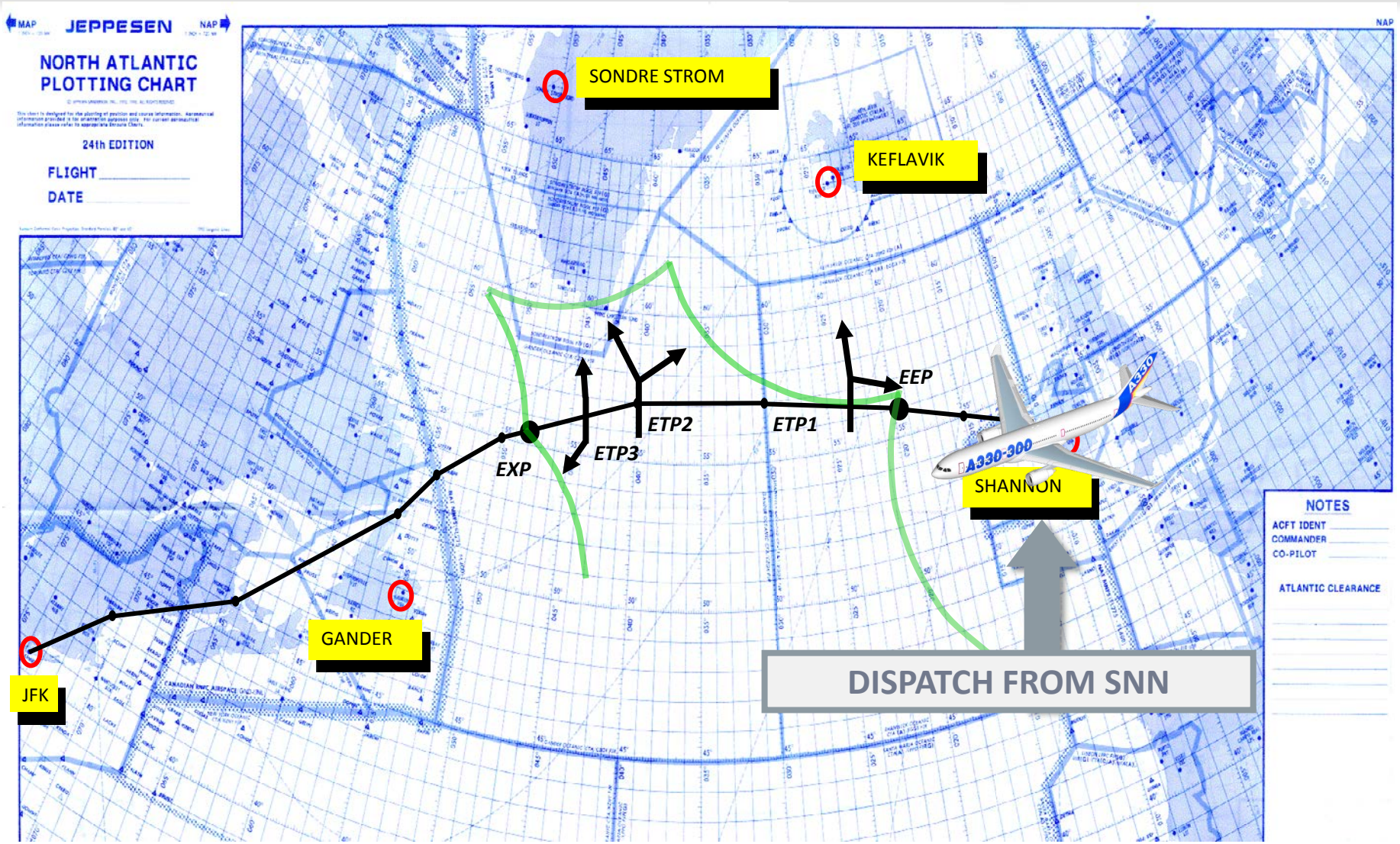
EDTO Flight Crew Considerations

EDTO Flight Crew
Considerations*

- Dispatch
- Cockpit Preparation
- En-route
- Diversion Decision
- Diversion Strategies *(Speed Selection)*
- Post Flight

**** Note: Refer to Company Operating Procedures***

Dispatch
Continued



Dispatch
Continued

Check Aircraft Configuration

- Check EDTO / ETOPS Status of the aircraft (MEL/CDL)
- Check Time Limited Systems

Nominate EDTO Alternate Airports

Consider EDTO Fuel Requirements

Prepare Flight Folder

AIRCRAFT DATE ETD	REGISTRATION FLIGHT N° DESTINATION
ETOPS STATUS	
ETOPS APPROVED : COMPANY	✓
ETOPS APPROVED : CREW	✓
ETOPS APPROVED : ROUTE	✓
MAINTENANCE RELEASE STATEMENT	✓
MEL/CDL	✓
TIME LIMITED SYSTEM	✓
NOTAMS	
Departure Airport	
Destination Airport	
En route alternates	
En route	
WEATHER FOLDER	
TAF METARS SIGMETS: Departure Airport Destination Airport En-route Alternate	
WINDS AND TEMP CHARTS Cruise FL Diversion FL	
TEMSI charts	
ICING FORECAST	

Dispatch
Continued

Check Aircraft Configuration

- Check EDTO / ETOPS Status of the aircraft (MEL/CDL)
- Check Time Limited Systems

Nominate EDTO Alternate Airports

- Check NOTAM
- Check Weather (TAF/METAR)

Consider ETOPS Fuel Requirements

Prepare Flight Folder

AIRCRAFT DATE ETD	REGISTRATION FLIGHT N° DESTINATION
ETOPS STATUS	
ETOPS APPROVED : COMPANY	✓
ETOPS APPROVED : CREW	✓
ETOPS APPROVED : ROUTE	✓
MAINTENANCE RELEASE STATEMENT	✓
MEL/CDL	✓
TIME LIMITED SYSTEM	✓
NOTAMS	
Departure Airport	✓
Destination Airport	✓
En route alternates	✓
En route	✓
WEATHER FOLDER	
TAF METARS SIGMETS: Departure Airport Destination Airport En-route Alternate	✓
WINDS AND TEMP CHARTS Cruise FL Diversion FL	
TEMSI charts	
ICING FORECAST	

Dispatch

Check suitability of adequate aerodromes

```
EINN APT 19990412778V01 A0426/99    99 12APR1400/99 16APR1730
ILS RWY06 OUT OF SERVICE

EINN APT 19990409492V01 A0416/99    99 15APR0700/99 15APR1900
CRANE MAX HGT 45M/148FT AGL OPR PSN 524301.88N0085127.12W
  LIGHTED RED

EINN APT 19990409474V01 A0415/99    99 15APR1900/99 30DEC1700 EST
CRANE MAX HGT 40M/131FT AGL OPR PSN 524301.88N0085127.12W
LIGHTED RED

EINN APT 19990407715V01 A0407/98    99 15APR0700/99 15APR1900
CRANE MAX HGT 45M/148FT AGL OPR PSN 524301.88N0085127.12W LIGHTED
  RED

EINN APT 19990405791V01 A0395/99    99 06APR0815/99 13APR1700 EST
RESCUE LAUNCH UNSERVICEABLE
REF AIP EINN AD 2-3

EINN APT 19990226312V01 A0187/99    99 22FEB1920/99 30JUN1600 EST
REF AIP PAGES EINN AD 2-18
  EINN AD 2-20 EINN 2-21
  AIP SECTION EINN AD 2-22
  INTRODUCTION OF SURVEILANCE RADAR APPROACHES DEFERRED.

EINN APT 19990130504V01 A0053/99    99 19JAN1230/99 30APR1600 EST
CAUTION ADVISED WHEN TURNING ON TURNING AREA AT END RWY24
  DUE POSSIBILITY OF LOW FRICTION PARTICULARLY IN WET CONDITIONS)

EINN APT 19980732208V01 A1078/98    98 29JUL1000/     PERM
AMEND MSA AS FOLLOWS
  SECTOR 150 TO 240 - 2800FT
  SECTOR 240 TO 330 - 3400FT
  SECTOR 330 TO 060 - 2800FT
  SECTOR 060 TO 150 - 2400FT
  REF PAGES EINN AD 2.24-7, EINN AD 2.24-8, EINN 2.24-9.
```

NOTAMS

Dispatch

Check suitability of adequate aerodromes (Cont)

```
EINN METAR 130830Z 30019G36KT 8000 -SHRA FEW008 BKN018CB BKN045 07/00
 Q1013 NOSIG
EINN METAR 130800Z 31016KT 9999 FEW020 SCT045 07/M01 Q1013 NOSIG
EINN METAR 130800Z NIL
EINN METAR 130730Z 31016KT 9999 FEW020 SCT045 07/M02 Q1013 NOSIG
EINN METAR 130700Z 32014KT 9999 FEW020 06/M02 Q1013 NOSIG


12Z  3145M10 3153M16 3166M20 3195M26 8110M38 8110M50 3192M55 3069M54
18Z  3135M10 3140M17 3155M21 3087M28 8004M40 8001M51 3082M53 3160M52
00Z  3427M12 3426M19 3336M25 3159M35 3079M42 3074M46 3164M48 3150M49
06Z  3337M11 3437M18 3438M26 3340M41 3344M47 3248M45 3249M46 3243M47


BIKF TAF 130400Z 130606 01020KT 9999 SCT025 BECMG 0002 33005KT
 CAVOK

BIKF TAF 130700Z 130918 01020KT 9999 SCT018

BIKF METAR 130830Z 02022KT 9999 BKN028 M03/M09 Q1028
BIKF METAR 130800Z 02022KT 9999 BKN030 M03/M09 Q1027
BIKF METAR 130730Z 01023KT 9999 BKN030 M03/M11 Q1027
BIKF METAR 130700Z 01023KT 9999 BKN030 M04/M11 Q1027


12Z  0126M18 0128M22 0137M27 3655M37 3567M45 3469M50 3460M49 3349M49
18Z  0022M16 0021M19 3632M24 3558M33 3573M45 3576M52 3466M53 3454M52
00Z  3422M14 3426M17 3435M21 3557M29 3471M43 3482M54 3473M55 3461M54
06Z  3123M14 3227M16 3232M20 3343M30 3361M42 3369M55 3365M57 3355M54


BGSF TAF 130511Z 130606 VRB08KT 9999 SCT180 BECMG 0911 SCT035 BKN090
 PROB30 1218 4000 SNRA VV030
```

WEATHER

Dispatch
Continued

Check Aircraft Configuration

- Check EDTO Status of the aircraft
- Check Time Limited Systems

Nominate EDTO Alternate Airports

- Check NOTAM
- Check Weather (TAF/METAR)

Consider EDTO Fuel Requirements

Prepare Flight Folder

AIRCRAFT DATE ETD	REGISTRATION FLIGHT N° DESTINATION
ETOPS STATUS	
ETOPS APPROVED : COMPANY	✓
ETOPS APPROVED : CREW	✓
ETOPS APPROVED : ROUTE	✓
MAINTENANCE RELEASE STATEMENT	✓
MEL/CDL	✓
TIME LIMITED SYSTEM	✓
NOTAMS	
Departure Airport	✓
Destination Airport	✓
En route alternates	✓
En route	✓
WEATHER FOLDER	
TAF METARS SIGMETS: Departure Airport Destination Airport En-route Alternate	✓
WINDS AND TEMP CHARTS Cruise FL Diversion FL	
TEMSI charts	
ICING FORECAST	

Dispatch
Continued

```
PLAN 8250                EINN TO KJFK G330  M81/F  IFR  04/13/99
NONSTOP COMPUTED 0838Z   FOR ETD 1200Z   PROGS 1300ADF  ED330PW  KGS

ATTN CAPT.
FLT RELEASE    AIB330    EINN/KJFK ON 04/13/99

   ///// THIS LOG INCORPORATES THE ETOPS  120 MIN RULE /////

     FLT/DAY  ORG /DEST   TTL NAM  PRF  ROUTE  AVG WIND/ AVG TEMP / AVG TT
AIB330  /13   EINN/KJFK     3132    F    ED     M048   /   M52    / 255

PERFORMANCE FACTOR = 1%              AIRCON NORMAL
MEL/CDL STATUS : APU INOP.

            E.FUEL  A.FUEL  E.TME   NM    NAM  FL
DEST  KJFK 037719  ... ..  06/51  2792  3132   370/DEVOL 390/CARPE
RESV  0.05 001886  ... ..  00/22
ALT   KBOS 003250  ... ..  00/31  0183  0184 240
HOLD       002564  ... ..  00/30
ETOPS RES  000000  ... ..  00/00
ETOPS XPRT 000000  ... ..  00/00
XTR        000000  ... ..  00/00  CAPT.SIGN . . . . . .
TOF        045419  ... ..  08/14
TAXI       000300  CORR.   + / -
BLOCK      045719  ... ..  08/14  BLOCK FUEL. . . . . .

FUEL BURN ADJUSTMENT FOR 4000FT DECREASE IN CRZ ALTITUDE :     KGS

FUEL BURN ADJUSTMENT FOR 1000KGS INCREASE/DECREASE IN TOW : 0173 KGS
```

Dispatch
Continued

Check Aircraft Configuration

- Check EDTO Status of the aircraft
- Check Time Limited Systems

Nominate EDTO Alternate Airports

- Check NOTAM
- Check Weather (TAF/METAR)

Consider EDTO Fuel Requirements

Prepare Flight Folder

AIRCRAFT DATE ETD	REGISTRATION FLIGHT N° DESTINATION
ETOPS STATUS	
ETOPS APPROVED : COMPANY	✓
ETOPS APPROVED : CREW	✓
ETOPS APPROVED : ROUTE	✓
MAINTENANCE RELEASE STATEMENT	✓
MEL/CDL	✓
TIME LIMITED SYSTEM	✓
NOTAMS	
Departure Airport	✓
Destination Airport	✓
En route alternates	✓
En route	✓
WEATHER FOLDER	
TAF METARS SIGMETS: Departure Airport Destination Airport En-route Alternate	✓
WINDS AND TEMP CHARTS Cruise FL Diversion FL	
TEMSI charts	
ICING FORECAST	

Dispatch

Prepare Flight Folder

FLIGHT SUMMARY

DISPATCH BRIEFING	(TEL : +33141568545)
DISPATCHER	: BERTRAND DURAND
SATCOM	: DISPATCH WEST
FLIGHTPLAN STATUS	: FINAL
REGISTRATION	: FGSQC
TYPE	: B777-300
STD/SLOT/TSAT/CTOT	: 1255/...
GATE	: F09
MEL/CDL ITEMS/CORR	: NIL
NOTOC	: YES/NO
ROUTE/FLT LEVEL	: C-TRACK TRAVERSEE ATLANTIQUE AU FL380
TMI	: *if tracks*
WEATHER	: NO SIGWX
FUEL	: CARBU SUPP 2T CAUSE ATTENTE ATC
COST INDEX	: 240
ETOPS STATUS	: 180
ETOPS APPUIS	: EINN/CYYR
CONNECTIONS	: 1ERE CONNECTION A 23h30 ARR 3MIN RTD COUTE 89EUR
FUEL DENSITY	: 0,795
MISCELLANEOUS	

NOTAM/WEATHER BULLETIN

Index:

DEPARTURE AIRPORT - DETAILED INFO 29
DESTINATION AIRPORT - DETAILED INFO 31
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ETOPS SUITABLE ENROUTE AIRPORT(S) 41
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CREW ALERT 65
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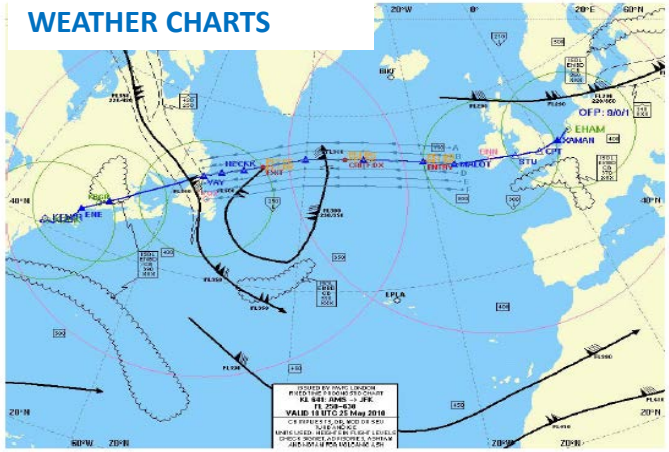
AIRCRAFT BULLETIN 69
WEATHER BULLETIN 70

WEATHER CHARTS



FLIGHT PLAN

LFPG/CDG	**KJFK/JFK**	CRZ SYS	CI240		
1255/1313	2050/2058	GND DIS	3460		
CTOT:	STA 2140	AIR DIS	3426		
		AVG W/C	T006		
		AVG ISA	P01		
		F-F FACTOR	+4.0		

LIMITATIONS

MAXIMUM	ZFW 170000	LAW 182000	TOW 228000		
ESTIMATED	ZFW 153500	LAW 158241	TOW 199059		
ACTUAL	ZFW	LAW	TOW		

FUEL

TRIP	**40818**	**0737**		.....	.....
CONT 3/5%	**879**	**0013**		.....	.....
ALTN	**1818**	**0020**	KEWR	.....	.....
FINAL	**2044**	**0030**		.....	.....
PLN TOF	**45519**	**0840**			
ALTN DIFF	....	.....			
PLN TOF	....	.....	(CORRECTED)		
EXTRA	....	.....			
TAXI	600	0017			
K Factor	1.212				

ETOPS SUMMARY

EEP(EINN)391	N5358.7W01952.7	EET 02.10 ETO....	CF(Y) 9.7	EFOB 36.2
EINN 24	REQ 1436-1857 WX MIN 400/1350	FCWX 999/9999	XWC 3.0	
ETP(DX) 844	N5505.3W03306.3	EET 03.12 ETO....	CF(Y) 19.5	FOB 29.8
CYQX 03	REQ 1633-1857 WX MIN 600/3219	FCWX 040/9999	XWC 23.6	
EXP(CYQX)366	N5341.2W04705.9	EET 04.11 ETO....	CF(Y) 9.0	EFOB 23.4

MISCELLANEOUS

Free Text

Cockpit preparation

Pre-Takeoff Checks

Specific pre-takeoff checks

- Flight crew : e.g. fuel x-feed valve, CSM/G
- Maintenance : e.g. engine oil level and DPI.

Checks may vary with aircraft model

DATA in FMGS

- EEP, ETP, EXP, CRUISE WINDS
- Entered as “FIX INFO” or “ABEAM”
  - display these points on the ND
  - no need to create additional waypoints in the F-PLN, to avoid these points being transmitted via CPDLC or ADS

Cockpit preparation

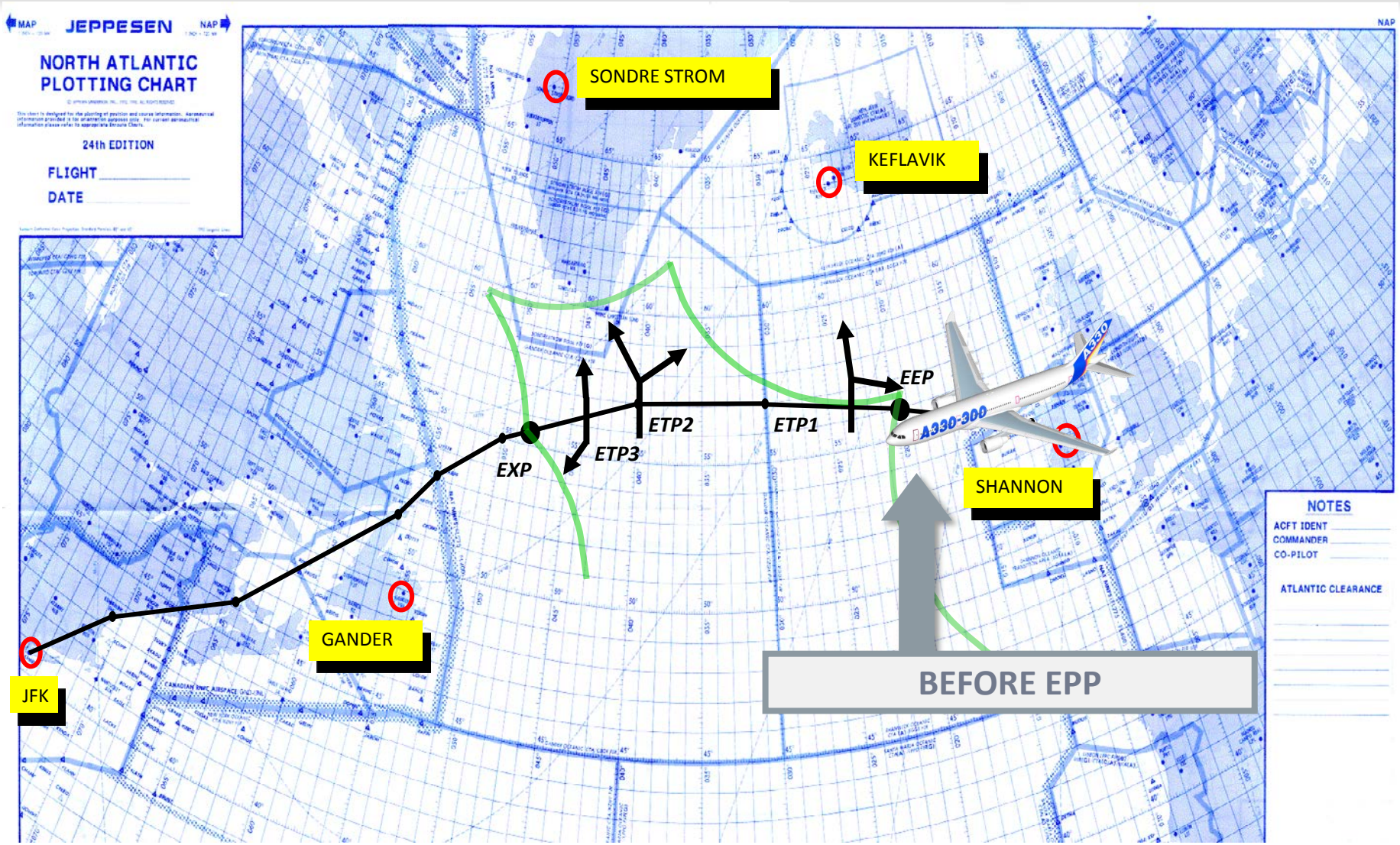
Continued

Cockpit preparation
Continued

The ETP computed by the FMGS (AEO) is different from the EDTO ETP (OEI).

Cockpit preparation

Before EDTO sector



Cockpit preparation

Before EDTO sector (Cont)

Crew Notifications

Crew must be notified of any significant changes affecting:

- Forecast weather
- Aerodrome availability
- Any other required services at EDTO alternate airports designated for the flight.

Cockpit preparation

Before EDTO sector

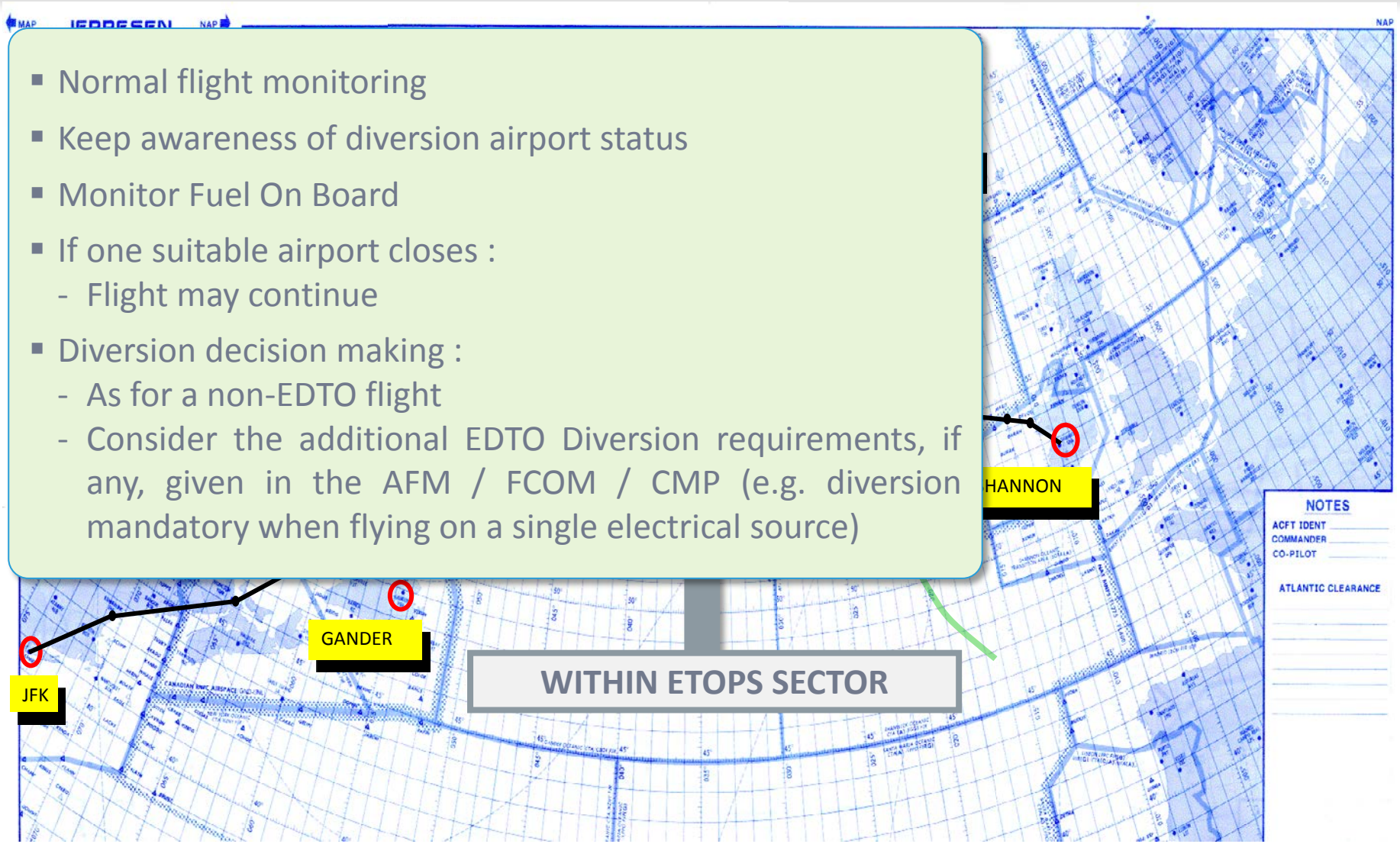
EDTO Alternates Status

Crew must check any changes that would preclude a safe approach and landing at an EDTO alternate airport during the time window

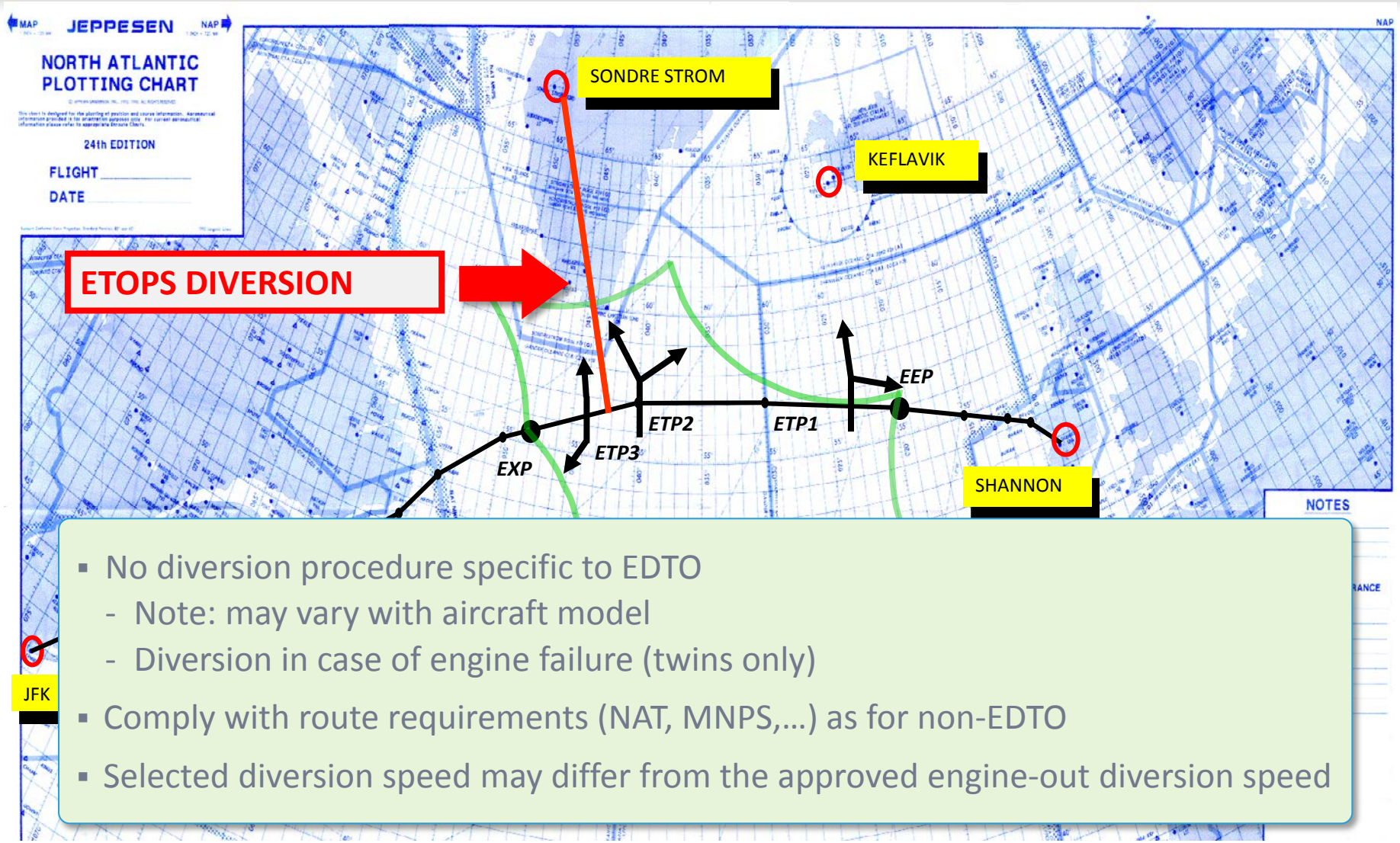
- Check minima at diversion airfields, …
- Appropriate course of action must be taken if normal minima not fulfilled before EEP:
  - Selection of another EDTO alternate airport, re-routing, turn back,
  - Consider A/C EDTO capability and operator's approved max DT in case of re-routing or selection of another EDTO alternate

Flying the EDTO sector

- Normal flight monitoring
- Keep awareness of diversion airport status
- Monitor Fuel On Board
- If one suitable airport closes :
  - Flight may continue
- Diversion decision making :
  - As for a non-EDTO flight
  - Consider the additional EDTO Diversion requirements, if any, given in the AFM / FCOM / CMP (e.g. diversion mandatory when flying on a single electrical source)

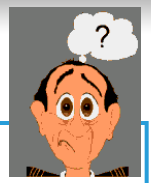


EDTO diversion



- No diversion procedure specific to EDTO
  - Note: may vary with aircraft model
  - Diversion in case of engine failure (twins only)
- Comply with route requirements (NAT, MNPS,…) as for non-EDTO
- Selected diversion speed may differ from the approved engine-out diversion speed

Appendix 7 to EASA AMC 20-6 (Typical Format)



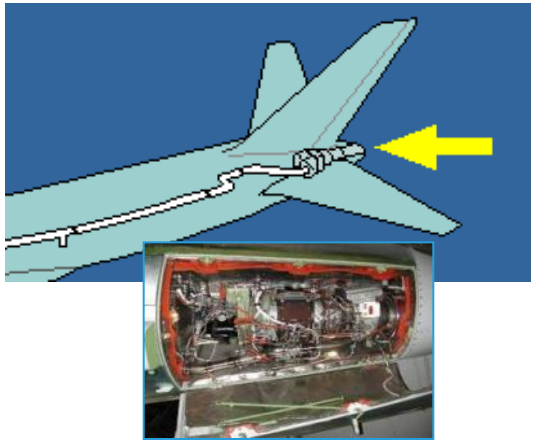
- Part A: General/Basic
  - Introduction, Operations approval, Training & checking, Operating procedures, flight preparation & planning…
- Part B: Aeroplane Operating Matters
  - Type specific operations, dispatch, flight planning, enroute, fuel planning, MEL/CDL, aeroplane systems…
- Part C: Route and Aerodrome Instructions
  - EDTO area and routes, enroute alternates, weather, CFP information, minimum altitudes, aerodrome characteristics…
- Part D: Training
  - Operators initial/recurrent route and aerodrome training programs.

- Definitions
- EDTO Operational Concepts
- EDTO Fuel Requirements
- Diversion Strategies
- Flight Crew Procedures
- EDTO Training

APU High Altitude Start Program

AC 120-42B Section 301, AMC 20-6 Appendix 8

- Required for all airplanes unless APU must be running for EDTO *(e.g. 737)*
- Start attempts made and recorded per operators approved sampling program*
  - On non-EDTO Flights
  - On return leg of EDTO Flights
- Supports EDTO Maintenance Program (common checklist item)
  - Flight crew performs start attempts
  - Reliability section tracks data
- Target 95% start reliability or attend to system *(12 month rolling average)*



DATE: 02/08/03

XYZ Airlines
ETOPS APU INFLIGHT START REPORT
B777 (GTCP331-500)

Percentage of successful first start attempts, last 3 month period: 96%

	JAN06	FEB06	MAR06	APR06	MAY06	JUN06	JUL06	AUG06	SEP06	OCT06	NOV06	DEC06	JAN07
Total Number of Attempts	9	9	9	9	9	9	9	9	9	9	9	9	9
1st Attempt Success	9	9	9	9	9	9	9	9	9	9	8	9	9
2nd Attempt Success	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A
3rd Attempt Success	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Monthly First Start Success Percentage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	89%	100%	100%

N/A = Start Not Attempted

Prepared by:
B. Boeing - XYZ Airlines Reliability

** Minimum 2 hour cold soak at normal planned cruise altitude*

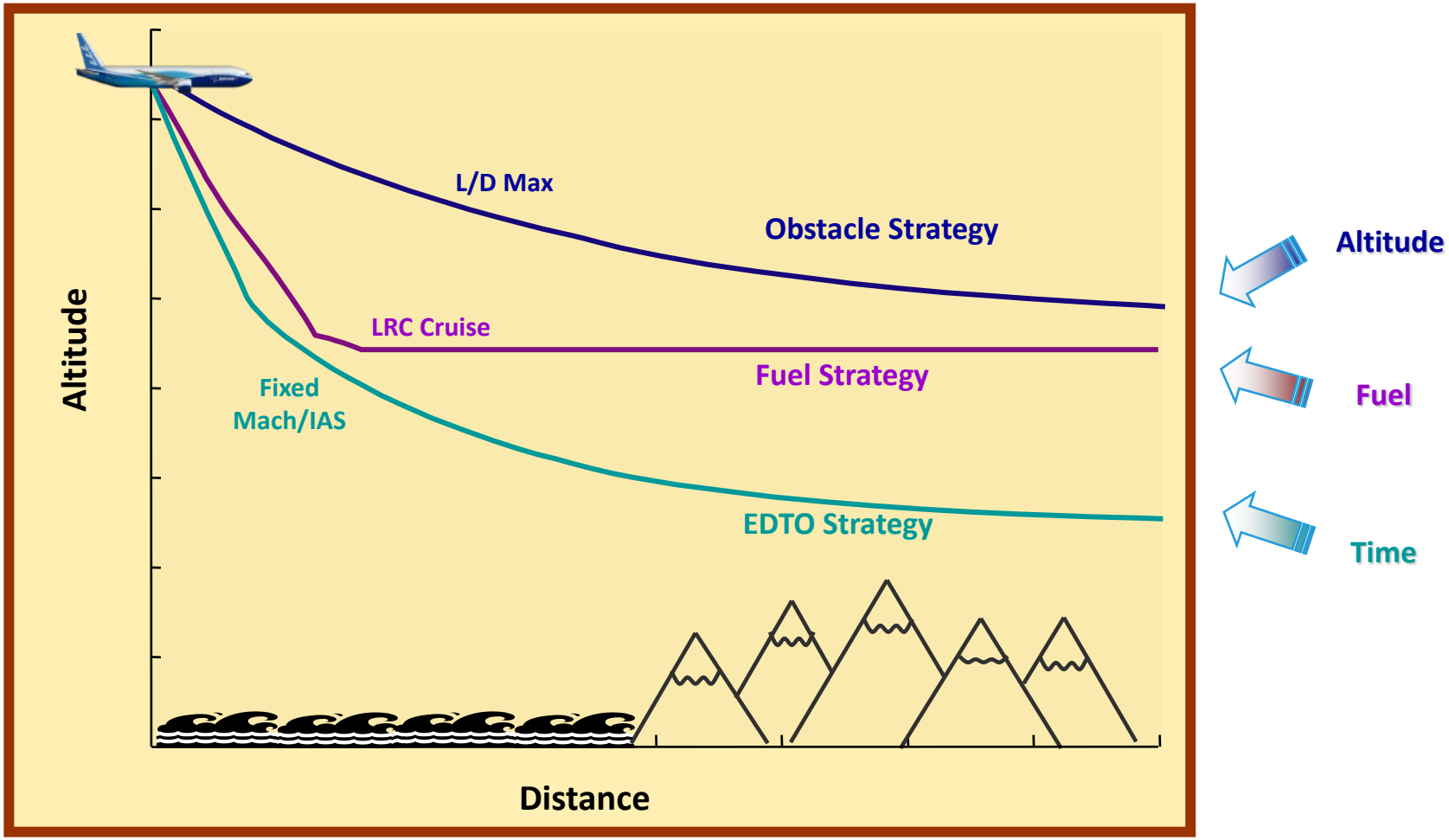
Alternate Aerodromes En-route Engine Failure

Two Engine Airplanes

Chapter 3 of AC 120-42B

- Following engine failure or shutdown, the PIC must proceed to the nearest suitable airport at which a safe landing can be made *(FAR 121.165)*
- The PIC should consider all relevant factors in determining the suitability of an airport
  - Airplane configuration, system status and fuel
  - En-route winds, weather and minimum altitudes
  - Airport weather, terrain and runway conditions
  - Approach aids, lighting, RFFS and passenger facilities
  - PIC familiarity and available airport information
- None of the following justify flying beyond the nearest suitable airport:
  - Available fuel supply
  - Passenger accommodation other than safety
  - Maintenance/repair resources

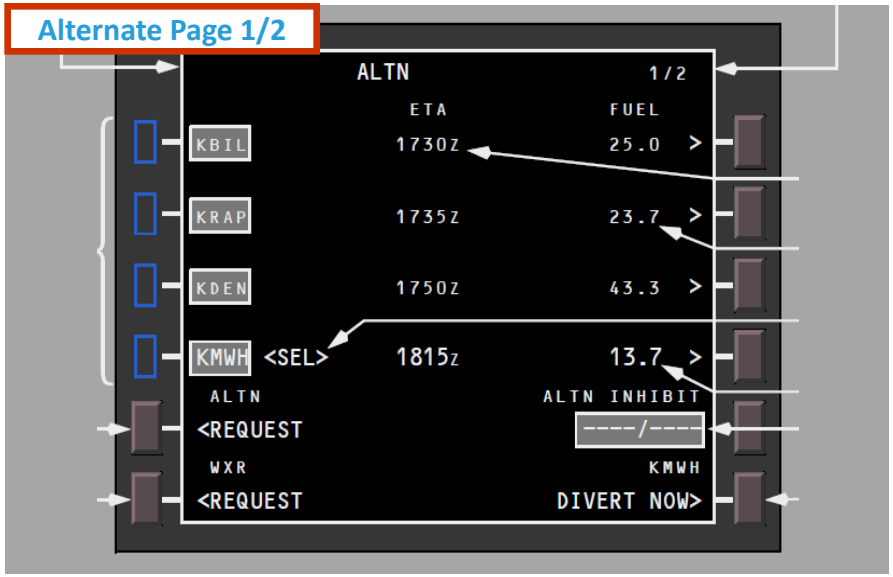
Engine Inoperative Diversion Strategies (Speed Selection)



Note: Offset or waypoint track may be required to meet airspace constraints

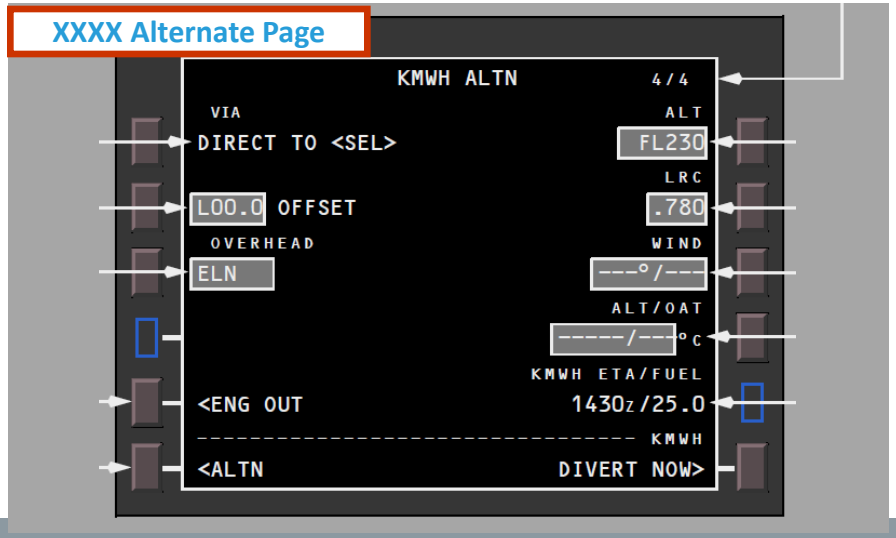
787 FMC Alternate Airports Function

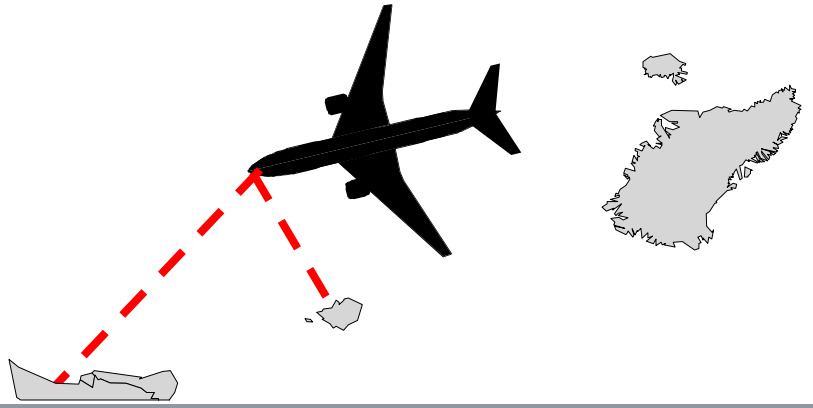
Alternate Page 1/2



- Reduces Diversion Task Load
  - Candidate airports automatically prioritized by ETA
  - Uplink capability for up to 20 alternates
  - Direct, offset or 'overhead' routing
  - Engine out performance data

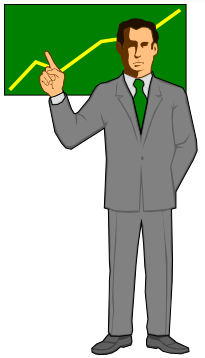
XXXX Alternate Page





EDTO Flight Operations Training

Training should address airline specific operating policies



TYPICAL SYLLABUS ELEMENTS

(Refer to AC 120-42B Section 304 and AMC 20-6, Appendix 6)

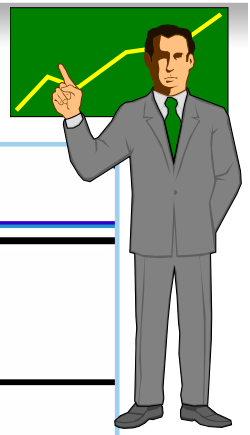
- Familiarity with EDTO rules
- Flight planning
- Engine inoperative speeds
- Alternate requirements
- En-route procedures
- Weather forecasting *(if required)*
- Critical point calculation
- Diversion recovery plan *(if applicable)*
- Critical fuel reserves
- Minimum equipment list
- EDTO critical systems
- Dispatch release
- Diversion decisions
- Diversion profile
- PIC responsibilities

Practical application of academics training

ROUTE OF FLIGHT

ORIGIN	London Heathrow Airport (EGLL)
	Parking Stand 319, RWY 27L
DESTINATION	Chicago O'Hare International Airport (KORD)
ALTERNATE	Indianapolis International Airport (KIND)
ROUTE	Computer Flight Plan (CFP)

GR WT	462,400 lbs	(209,000 kg)	FLAPS	OPTIMIZE
FUEL	107,400 lbs	(48,000 kg)	CG	28%
ZFW	355,000 lbs	(161,000 kg)	WIND	Calm



2-1 787
ETOPS LOFT NORTH ATLANTIC

PREFLIGHT
- Normal procedures
- ETOPS preparation

ENGINE START
- Normal procedures
- Pushback from gate during start

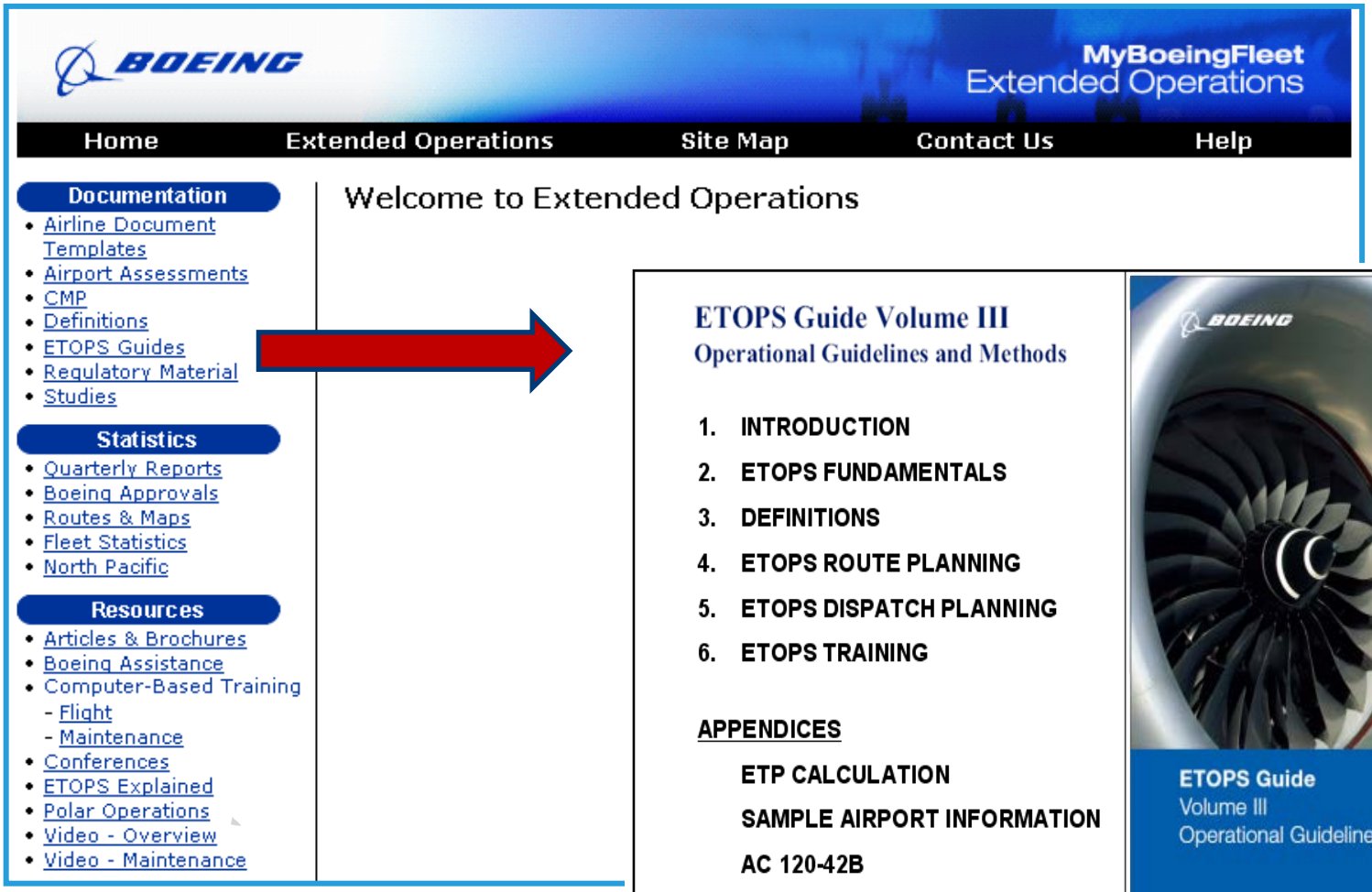
TAXI OUT
- Normal procedures

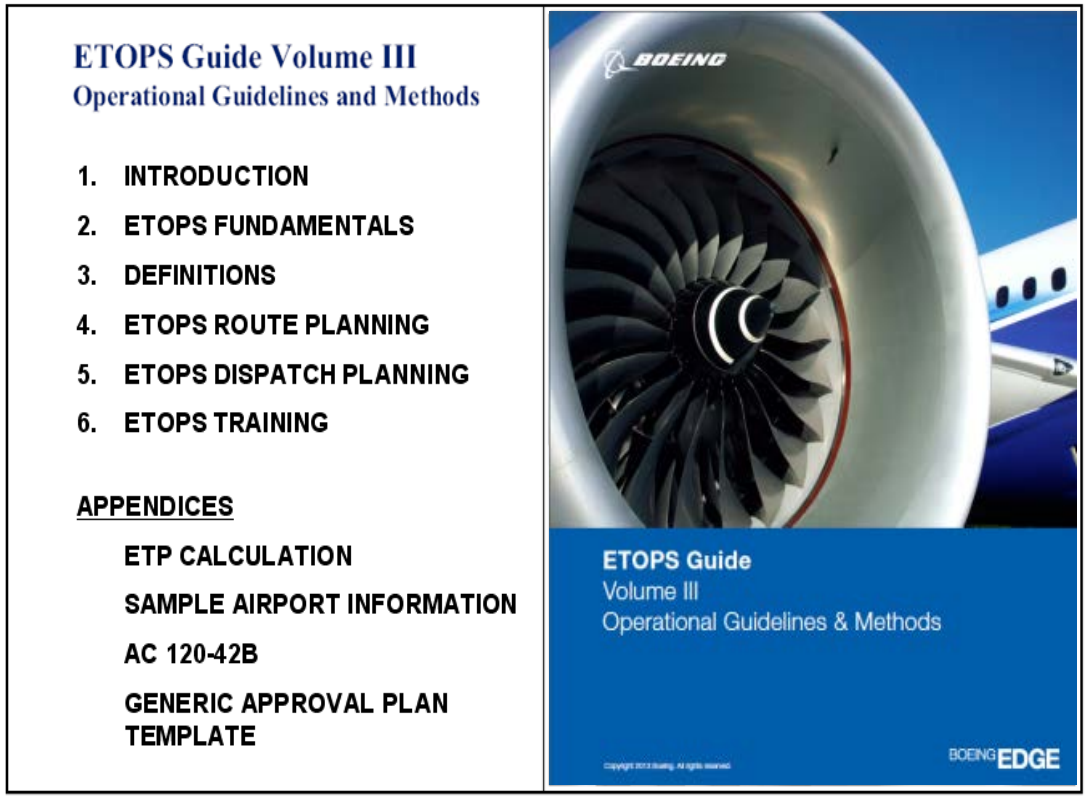
TAKEOFF
- Normal procedures
- Heavy weight takeoff

Example

CLIMB AND CRUISE
- Normal procedures
- Complete normal cruise level off
- Navigation performance degradation exercises prior to entering MNPS area
- RVSM requirement degradation exercises
- Reposition to point prior to EEP
- Before ETOPS Entry Point (EEP):
  - Complete ETOPS Company Operating procedure
  - Obtain weather updates for Enroute Alternates
  - Check FMS BRG/DIST to next alternate

Additional Boeing Guidance Information



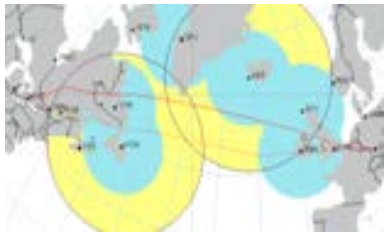


Agenda

- Defining the EDTO area of operations
- Performing EDTO Flight Planning
- Conducting EDTO Flights
- Conclusions

Conclusions

EDTO Area of Operation



EDTO Flight Operation

EDTO Flight

No Day Conditions

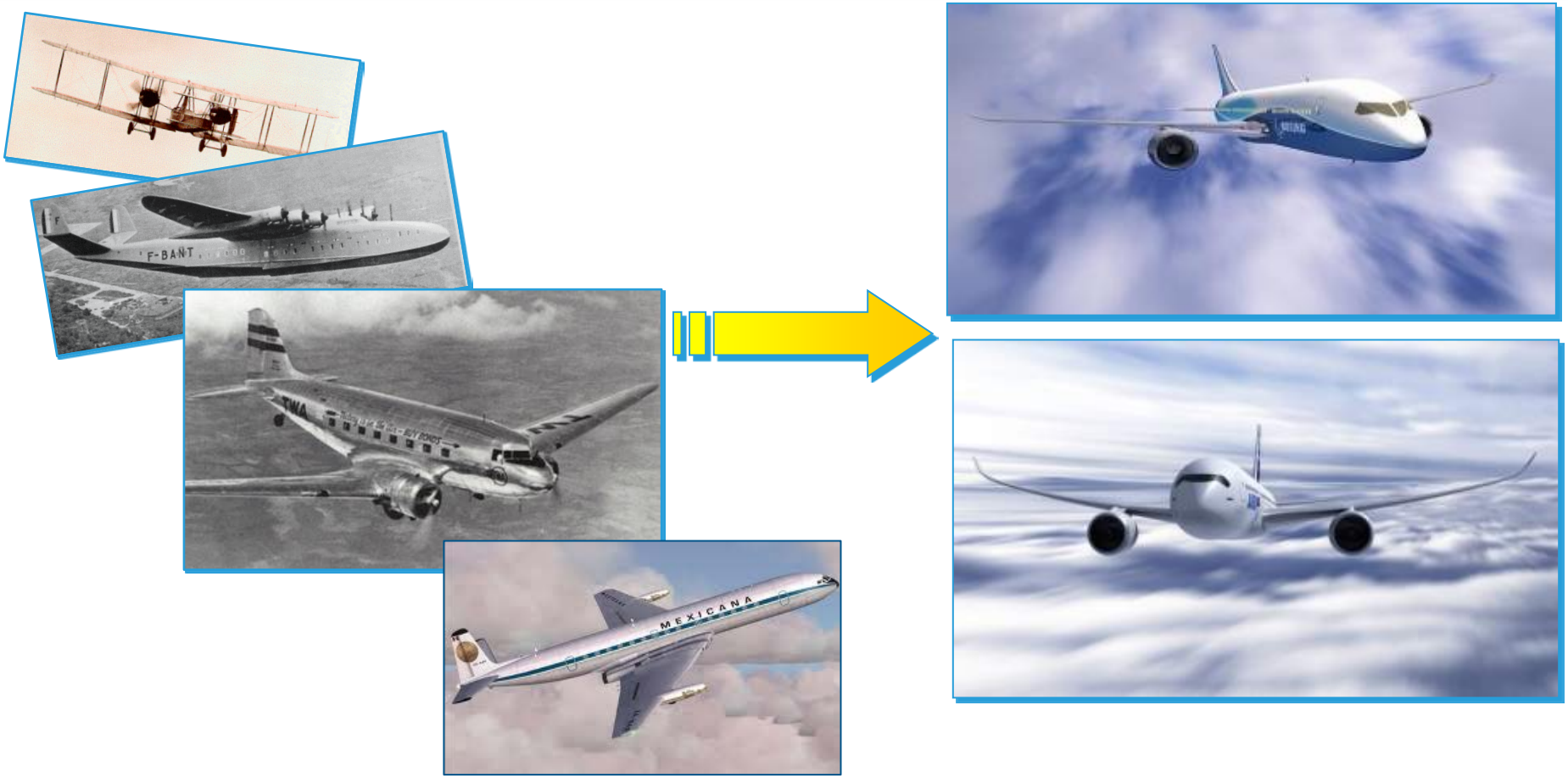
- **Approved diversion speed strategy**
- **Operator's approved EDTO Diversion Time**

Day Conditions

- **EDTO alternate airports** : weather minima + margins, period of suitability
- **Time-limited System**
- **EDTO Fuel:**
  - **3 diversion scenarios**
  - **Additional fuel reserves :** icing, wind forecast, …
- **Pre-flight Checks**
- **WTH/NTM Follow up**
- **Similar diversion decision making**

Module 6

EDTO Flight Operations considerations



Thank You !!