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Doc 10085

Extended Diversion Time Operations (EDTO) Manual

First Edition, 2017

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

FOREWORD

This manual provides guidance on and interpretation of the extended diversion time operations (EDTO) elements introduced through Amendment 36 to Annex 6, Part I, Section 4.7 and Attachment C. The amendment represents the culmination of over ten years' work to develop and refine the provisions in a manner that benefits both air operators and regulators.

These new EDTO provisions are based on best practices and lessons learned from extended range operations by aeroplanes with two turbine engines (ETOPS) to ensure that all operators and new entrants operate at the same level of safety in order to maintain the current track record of long-range operations.

In short, the new EDTO Standards:

a) allow longer EDTO operations for aeroplanes with two turbine engines, based on the propulsion reliability and overall operational safety of current ETOPS twins. The related criteria have been evolved from the ETOPS Standards which previously existed in ICAO's Annex 6; and

b) introduce similar measures to EDTO operations of aeroplanes with more than two turbine engines, through a few additional operational requirements (consideration of time-limited system (TLS)/policy for selection and monitoring of en-route alternates). There are neither additional maintenance requirements for EDTO operations of aeroplanes with more than two engines, nor any additional certification requirements. This means that for EDTO with more than two engines, neither the basic type certification nor the maintenance programme needs to be reviewed as both remain valid for EDTO operations.

Accordingly, this manual details the Standards, policies, procedures and guidelines for operations by transport category aeroplanes with turbine engines conducted beyond 60 minutes from a point on a route to an en-route alternate aerodrome, and for obtaining EDTO certification and/or EDTO specific approval for these aeroplanes to operate farther than the applicable EDTO threshold time.

This manual is intended to be used by:

a) policy makers from the civil aviation authority (CAA), in the implementation of the ICAO Standards related to EDTO in their State regulations;

b) oversight inspectors from the CAA, in granting EDTO specific approvals and exercising oversight of EDTO operations; and

c) concerned airline staff (from both flight operations and maintenance/engineering organizations) in the preparation to introduce new or revised EDTO operations, or when assessing compliance of existing EDTO operations and procedures versus the new EDTO Standards.

The content of this manual should not be considered as the only means of compliance with EDTO requirements. There may be other acceptable means of compliance published by the relevant State.

Note concerning the use of the terms "EDTO" vs "ETOPS"

ICAO decided, through Amendment 36 to Annex 6, Part I, to replace the previously used term ETOPS (extended range operations by twin-engined aeroplanes) with the new term EDTO (extended diversion time operations). The main reason for this change in the terminology was to better reflect the scope and applicability of these new Standards.

Nevertheless, this name change is not intended to mandate a similar name change in the concerned State regulations or aircraft documentation. This is in line with the note introduced in the EDTO Standards of Annex 6, which clarifies that the term “ETOPS” may still be used instead of “EDTO”, as long as the concepts are correctly embodied in the concerned regulation or documentation.

This manual has been produced with the participation and cooperation of members of the following organizations:

- International Air Transport Association (IATA)
- International Coordinating Council of Aerospace Industries Associations (ICCAIA)
- International Civil Aviation Organization (ICAO):
    - Cooperative development of operational safety and continuing airworthiness programme (COSCAPS)
    - Flight Operations Panel (FLTOPSP)
    - Special Operations Task Force (SOTF).

Note concerning the use of terms, “authorization”, “acceptance”, “approval” and “specific approval”

The FLTOPSP of ICAO has been working to standardize the use of these terms in Annex 6. As a result of this work, the following definitions have been agreed and will be used throughout this document:

Authorization: An authorization entitles an operator, owner or pilot-in-command to undertake the authorized operations.

Acceptance: An acceptance is a written or implicit acknowledgment by the State of the Operator/State of Registry to an operator or owner of a notification submitted by, or on behalf of, that operator or owner.

Approval: An approval is a formal act by the State of the Operator/State of Registry to approve an application or a proposed change submitted by, or on behalf of, an operator or owner. The approval attests to compliance with the applicable provisions.

Specific approval: A specific approval is an approval which is documented in the operations specifications for commercial air transport operations, or in the list of specific approvals for non-commercial operations.

The generic term is therefore “authorization” which can be used in place of any of the other three terms. The term “approval”, which is often used as a generic term for the activity of the regulator granting permission to undertake a particular operation, should be limited to those occasions as described in the above definition.

For items relating to Annex 8, the term “type design approval” is used to refer to the granting of the type design by the State of Design.

Comments concerning this manual should be addressed to:

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Montréal, Quebec, Canada H3C 5H7

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GLOSSARY

ACRONYMS AND ABBREVIATIONS

AEC	Aeroplane/engine combination
AEO	All engines operative
AFM	Aircraft flight manual
APU	Auxiliary power unit
ATA	Air Transport Association
AWI	Airworthiness inspector
CAA	Civil aviation authority
CASS	Continuing analysis and surveillance
CBT	Computer-based training
CDL	Configuration deviation list
CFR	Critical fuel required
CMP	Configuration, maintenance and procedures
CMR	Certification maintenance requirements
CP	Critical point
DA	Decision altitude
DH	Decision height
ECM	Engine condition monitoring
EDTO	Extended diversion time operations
EEP	EDTO entry point
EFOM	EDTO flight operations manual
EGT	Exhaust gas temperature
EMPM	EDTO maintenance procedures manual
ETA	Estimated time of arrival
ETOPS	Extended range operations by aeroplanes with two turbine engines
ETP	Equal time point
EXC	Excess fuel
EXP	Exit point
FL	Flight level
FMS	Flight management system
FOB	Fuel on board
FOI	Flight operations inspector
FOM	Flight operations manual
GVI	General visual inspection
HF	High frequency
IAS	Indicated airspeed
ICA	Instruction for continuing airworthiness

IFSD	In-flight shut down
IPC	Illustrated parts catalogue
IPD	Illustrated parts data
ISA	International standard atmosphere
L/D	Lift over drag ratio
LOFT	Line-oriented flight training
LRC	Long-range cruise
MCAI	Mandatory continuing airworthiness information
MCT	Maximum continuous thrust
MDA	Minimum descent altitude
MDH	Minimum descent height
MEL	Minimum equipment list
MIN	Minute(s)
MMEL	Master minimum equipment list
MNPS	Minimum navigation performance specification
MPD	Maintenance planning document
MPM	Maintenance procedures manual
MRBR	Maintenance review board report
MRC	Maximum range cruise
MSN	Manufacturer serial number (i.e. serial number of the concerned aeroplane)
NOTAM	Notice to airmen
OEI	One-engine-inoperative
OFP	Operational flight plan
PBN	Peformance-based navigation
P/Ns	Part numbers
QRH	Quick reference handbook
RFFS	Rescue and firefighting service
RNP	Required navigation performance
RVR	Runway visual range
RVSM	Reduced vertical separation minimum
RWY	Runway
TAS	True air speed
TCDS	Type certificate data sheet
TLS	Time-limited system
VFG	Variable frequency generator
VMO/MMO	Maximum permissible operating speed or Mach number

DEFINITIONS

Definition of terms which are already defined in the SARPs. These definitions are identical to the ones provided in the Annexes.

*****Definition of terms introduced in this manual to support the implementation of the Standards (e.g. "EDTO en-route alternate"). Some terms may therefore be found in other publications with a different definition.)***

Aeroplane/engine combination (AEC)*.* A combination of aeroplane model and engine model which has been identified for the purpose of EDTO certification (also called type design and reliability approval) or authorized for EDTO. EDTO certification of a given aeroplane/engine combination (AEC) is identified on the type certification data sheet (TCDS). EDTO specific approval for a given AEC is identified in the operations specification, which may group minor model variants into a single authorization when they are substantially common from a configuration and operational programme perspective. The compliance demonstration required for the EDTO certification and/or EDTO authorization for a particular aeroplane/engine combination takes credit for the similarities with already certified or authorized AEC(s), such as minor models of an aeroplane type and sub-models of an engine installation, i.e. only the EDTO relevant differences (e.g. those having an impact on EDTO processes or procedures) between the candidate AEC and the already certified and/or authorized AEC(s) are addressed for new EDTO certification and/or EDTO specific approval.

Airworthiness inspector (AWI).** The representative of the civil aviation authority in charge of initial authorization and/or continued oversight of the operator's maintenance and engineering organization and processes. The assessment performed by the AWI may include (but not be limited to):

a) the adequacy of maintenance facilities, equipment and procedures;
b) the adequacy of the training programmes and competence of employees;
c) the adequacy of the programme or schedule for periodic maintenance and overhauls; and
d) the airworthiness of the aircraft.

***Alternate aerodrome**.** An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use. Alternate aerodromes include the following:

Take-off alternate. An alternate aerodrome at which an aircraft would be able to land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

En-route alternate. An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en route.

Destination alternate. An alternate aerodrome at which an aircraft would be able to land should it become either impossible or inadvisable to land at the aerodrome of intended landing.

EDTO alternate.** An en-route alternate aerodrome that is designated in a dispatch or flight release for use in the event of a diversion during an EDTO flight, and which meets the applicable dispatch minima (weather and field conditions). This definition applies to flight planning and does not in any way limit the authority of the pilot-in-command during flight.

Note.— En-route alternate aerodromes may also be the take-off and/or destination aerodromes.

EDTO — configuration, maintenance and procedures (CMP) document**. The document approved by the State of Design and which contains the particular aeroplane configuration minimum requirements, including any special inspection, hardware life limits, master minimum equipment list (MMEL) constraints and maintenance practices found necessary to establish the suitability of an aeroplane/engine combination (AEC) for extended diversion time operation.

EDTO — configuration, maintenance and procedures (CMP) requirements**. The particular aeroplane configuration minimum requirements including any special inspection, hardware life limits, MMEL constraints and maintenance practices found necessary to establish the suitability of an aeroplane/engine combination (AEC) for extended diversion time operation.

EDTO critical fuel*. The fuel quantity necessary to fly to an en-route alternate aerodrome considering, at the most critical point on the route, the most limiting system failure.

EDTO significant system*. An aeroplane system whose failure or degradation could adversely affect the safety particular to an EDTO flight, or whose continued functioning is specifically important to the safe flight and landing of an aeroplane during an EDTO diversion.

Extended diversion time operations (EDTO)*. Any operation by an aeroplane with two or more turbine engines where the diversion time to an en-route alternate aerodrome is greater than the threshold time established by the State of the Operator.

Flight operations inspector (FOI)**. The representative of the civil aviation authority in charge of initial authorization and/or continued oversight of the operator's flight operations organization and processes. The assessment performed by the FOI may include (but not be limited to):

a) the adequacy of flight operations facilities, equipment and procedures;
b) the adequacy of the training programmes and competence of employees; and
c) the adequacy of the programme to ensure safe operations of the aircraft.

Mandatory continuing airworthiness information (MCAI)**. The mandatory requirements for the modification, replacement of parts, or inspection of aircraft and amendment of operating limitations and procedures for the safe operation of the aircraft. Among such information is that issued by Contracting States in the form of airworthiness directives. (Definition from the *Airworthiness Manual,* ICAO Doc 9760.)

Maximum diversion time*. Maximum allowable range, expressed in time, from a point on a route to an en-route alternate aerodrome.

Operations specifications*. The authorizations, conditions and limitations associated with the air operator certificate and subject to the conditions in the operations manual,

Threshold time*. The range, expressed in time, established by the State of the Operator, to an en-route alternate aerodrome, whereby any time beyond requires an EDTO approval from the State of the Operator.

Type certification standards**. The data that are defined and approved by the State of Design in the frame of the Type Certification of the concerned aeroplane, e.g. baseline configuration, airworthiness limitations, flight crew procedures.

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Chapter 1

POLICY AND GENERAL INFORMATION

1.1 GENERAL

1.1.1 This manual provides the Standards, policies, procedures and guidelines for operations by aeroplanes with turbine engines conducted beyond 60 minutes from a point on a route to an en-route alternate aerodrome, and for obtaining EDTO certification and/or EDTO specific approval for:

a) two-engine transport category aeroplanes to operate over a specified route containing a point farther than applicable threshold time at the approved one-engine-inoperative (OEI) cruise speed (under standard conditions in still-air) from an adequate aerodrome. The threshold is a point on the route beyond which the provisions of this manual apply. Specific criteria are included for diversion times of 75, 90, 120, and 180 minutes, and beyond 180 minutes.

   The threshold time for such operations has to be established by the State. In doing so, the State should consider that the maximum diversion time capability of two-engine transport category aeroplanes not certified for EDTO is usually limited to 60 minutes. Therefore, the threshold time for such EDTO operations should normally be set at 60 minutes. It is possible to select a greater threshold time value further to a thorough assessment of the impact of such value on non-EDTO operations of non-EDTO certified two-engine transport category aeroplanes;

Note.— Previously issued specific approvals for ETOPS programmes continue to be valid; requests for new EDTO specific approvals or changes to existing programmes will be assessed under the criteria outlined in this manual.

b) transport category aeroplanes with more than two engines to operate over a specified route containing a point farther than applicable threshold time at the approved all-engines-operative (AEO) cruise speed (under standard conditions in still-air) from an adequate aerodrome. The threshold is a point on the route beyond which the provisions of this manual apply.

   The threshold time for such operations has to be established by the State. In doing so, the State should consider the specificities, if any, of such operations. Considering that the vast majority of long-range operations over the last 50 years have been conducted within 180 minutes maximum diversion time, and were not subject to any specific criteria, the threshold time for such EDTO operations should normally be set at 180 minutes. It is possible to select another threshold time value further to a thorough assessment of the impact of such value on existing operations and on the time limitations, if any, of transport category aeroplanes with more than two engines operated beyond the threshold time.

1.2 APPLICABILITY

This manual applies to transport category aeroplanes with two or more turbine engines where the diversion time to an en-route alternate aerodrome is greater than 60 minutes and/or than the threshold time established by the State of the Operator operated by an air operator in an international air transport service.

Note.— State regulations may establish further criteria related to aeroplane mass and passenger capacities to distinguish the applicability of EDTO requirements.

1.3 REFERENCE STANDARDS AND GUIDANCE MATERIAL

This manual supports Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, Section 4.7 and Attachment C. This manual can also be used in conjunction with other guidance materials such as the *Manual of Procedures for Operations Inspection, Certification and Continued Surveillance* (Doc 8335), the *Airworthiness Manual* (Doc 9760) and the *Flight Planning and Fuel Management (FPFM) Manual* (Doc 9976).

1.4 AUTHORIZATION PROCEDURES

1.4.1 Application for EDTO authorization

1.4.1.1 Requests for authorization of EDTO operations with aeroplanes having two or more engines should be submitted by the candidate EDTO operator with the necessary elements to the applicable civil aviation authority (CAA) office. These elements are those necessary for the CAA to determine the applicable authorization process (i.e. "in-service" or "accelerated" EDTO authorization – refer to Subsection 1.4.2) and launch the assessment of the operator's readiness for EDTO.

1.4.1.2 These necessary elements are typically:

a) the targeted date of start of EDTO;

b) the contemplated maximum diversion time authority;

c) the concerned aeroplane model(s) and fleet(s) (MSNs); and

d) the intended EDTO route(s) or operational area(s).

1.4.1.3 Other elements may be provided if deemed relevant by the candidate EDTO operator to support its application.

1.4.1.4 EDTO authorizations are specific approvals typically granted individually by aeroplane/engine combination (AEC) and area of operation; however, authorizations may be combined for model variations within the same aeroplane family (e.g. 737-700/800, A320/A321) and for multiple geographic regions.

1.4.1.5 The request for authorization of EDTO operations should be submitted as an advance notice in accordance with the five-phase process (refer to ICAO Doc 8335), so that the authority can plan and launch the necessary oversight actions.

1.4.1.6 The required duration of this advance notice prior to the proposed start of EDTO operations should be specified by the CAA. It should be typically:

a) from 60 up to 90 days for in-service EDTO authorization; and

b) up to 180 days for accelerated EDTO authorization.

1.4.2 EDTO specific approval requirements — aeroplanes with two turbine engines

1.4.2.1 For operations with transport category aeroplanes with two turbine engines, the EDTO specific approval requires:

a) validation or acceptance by the operator's CAA of the EDTO certification (also called EDTO type design and reliability approval) of the aeroplane granted by the State of Design of the aircraft manufacturer. The aeroplane type design should meet the requirements for EDTO design features and criteria specified in the regulations;

b) conformity of the "candidate" aircraft (MSN), including auxiliary power unit (APU) and engines, to the applicable EDTO configuration requirements listed in the EDTO configuration, maintenance and procedures (CMP) document;

c) a system to maintain and dispatch an EDTO aeroplane in accordance with an approved maintenance, reliability and training programme that includes EDTO requirements specified in Chapter 4;

d) demonstration that the maintenance checks, servicing and programmes called for in Chapter 4 are properly conducted;

e) demonstration that the operational limitations, flight preparation and in-flight procedures called for in Chapter 3 are properly conducted; and

f) authorization of the operator based on its application package: routes, desired diversion time, fleet, area of operations, planned date for the start of EDTO flights, experience records, manuals, training, etc.

1.4.2.2 The AEC and the general scope of the operation will be reviewed by the flight operations inspector (FOI) and the airworthiness inspector (AWI) to determine if there are any factors that could affect the safe conduct of operations before an operations specification is issued.

1.4.2.3 In summary, an operator that wants to operate EDTO flights with transport category aeroplanes with two turbine engines has to demonstrate that the aircraft is configured for EDTO and that the organization, means and processes comply with applicable EDTO regulation and, for transport category aeroplanes with two turbine engines only, with the EDTO CMP requirements.

1.4.2.4 The complexity of this demonstration is basically linked to:

a) the operator's experience with EDTO, long-range operations, the area of operation, the aircraft type, the engines, etc.;

b) the contemplated degree of direct in-service experience reduction; and

c) the type of intended EDTO operations (area of operations, frequency of EDTO flights, diversion time requested).

1.4.2.5 There are two types of EDTO authorization, either an "in-service" EDTO authorization or an "accelerated" EDTO authorization. The specific approval method for these authorizations are described hereafter, and related compliance demonstrations are detailed in this manual.

1.4.2.6 The specificity of an "accelerated" EDTO authorization is that the operator has to build a programme of process validation to address the lack of direct experience (with EDTO and/or with the candidate aircraft).

1.4.2.7 This process validation may involve transfer of experience and use of proven processes, simulated EDTO flights, assistance from an operator with EDTO experience, assistance from the manufacturer, etc. The main objective of this programme is the transfer of EDTO experience into the candidate operator's organization and operations. The required amount of process validation is directly linked to the operator's background and EDTO objectives.

1.4.2.8 ***"In-service" EDTO specific approval for operations with transport category aeroplanes with two turbine engines***

1.4.2.8.1 An "in-service" EDTO authorization by specific approval is either:

a) when the operator has accumulated more than one year of direct in-service experience with the aircraft without EDTO. In this case, the operator may apply for a diversion time of 120-minute maximum; or

b) when the operator has accumulated more than one year of EDTO experience at up to 120-minute maximum diversion time with the aircraft. In that case, the operator may apply for a diversion time of 180-minute maximum.

1.4.2.8.2 The required amount of prior in-service experience listed above may be reduced (or increased) at the discretion of the CAA.

Note.— Authorization for EDTO operations beyond 180-minute diversion time requires prior authorization for 180-minute EDTO operations. Authorization for EDTO operations beyond 240-minute diversion time requires a minimum of two years of experience with 180-minute or higher EDTO operations.

1.4.2.9 ***"Accelerated" EDTO specific approval for operations with transport category aeroplanes with two turbine engines***

1.4.2.9.1 An "accelerated" EDTO authorization by specific approval is either:

a) when the operator plans to start EDTO with less than one year of direct in-service experience with the aircraft; or

b) when the operator has accumulated direct in-service experience with the aircraft, but plans to conduct EDTO beyond 120 minutes with less than one year of 120-minute diversion time EDTO experience with the aircraft.

1.4.2.9.2 The operator may apply for any diversion time up to 180 minutes and may start EDTO at entry into service.

Note.— Authorization for EDTO operations beyond 180-minute diversion time requires prior experience with 180-minute EDTO operations.

1.4.3 EDTO authorization requirements — aeroplanes with more than two turbine engines

1.4.3.1 For operations with transport category aeroplanes with more than two turbine engines, the EDTO authorization by specific approval should require:

a) a review of the time capabilities of the relevant EDTO time-limited systems (TLSs). This review should be performed, although the EDTO certification is not required for an aeroplane with more than two engines, in order to adequately consider the relevant time capabilities during EDTO operations. On most aeroplanes with more than two engines, the only relevant TLS is the cargo fire protection system; and

b) authorization of the operator based on its application package: routes, desired diversion time, fleet, area of operations, planned date for the start of EDTO flights, experience records, manuals, training, etc.

1.4.3.2 The AEC and the general scope of the operation will be reviewed by the FOI and the AWI to determine if there are any factors that could affect the safe conduct of operations before an operations specification is issued.

1.4.3.3 In summary, an operator that wants to operate EDTO flights with transport category aeroplane with more than two turbine engines has to demonstrate that its organization, means and processes comply with applicable EDTO regulation and, for transport category aeroplanes with two turbine engines only, with the EDTO CMP requirements.

1.4.3.4 The complexity of this demonstration is linked to:

a) the operator's experience with EDTO, long-range operations, the area of operation, the aircraft type, the engines, etc.;

b) the contemplated degree of direct in-service experience reduction; and

c) the type of contemplated EDTO operations (area of operations, frequency of EDTO flights, diversion time requested).

1.4.3.5 There are no specific categories for EDTO authorization for operations with transport category aeroplanes with more than two turbine engines, i.e. there are neither specific diversion time categories nor specific methods of authorization.

1.4.4 Granting of EDTO authorization

1.4.4.1 The following criteria should be met prior to conducting EDTO operations:

a) satisfy the authorization considerations (operational criteria to be met for the granting of the authorization) specified in Chapter 3;

b) demonstrate that EDTO flight release practices, policies and procedures are established; and

c) conduct operational validation flight(s). Such validation flight(s) should be performed on proposed route(s) that the operator intends to operate, as detailed in its EDTO specific approval authorization request. The intent of the validation flight is to ensure that the required EDTO flight operations and maintenance (as applicable) processes and procedures are capable of supporting those operations.

Note.— Depending on the scope of EDTO authorization (operator experience with the area of operations and aircraft model, contemplated diversion time, etc.) the validation flight in the aeroplane may be replaced by a flight on an approved simulator.

1.4.4.2 When the foregoing has been reviewed and found acceptable, a recommendation from the FOI and the AWI will be forwarded to the responsible manager for authorization by specific approval, and the applicant will be issued an operations specification to conduct EDTO operations within specified limitations.

1.5 CONTINUITY OF EDTO CERTIFICATION — AEROPLANES WITH TWO TURBINE ENGINES (NOT APPLICABLE TO AEROPLANES WITH MORE THAN TWO ENGINES)

1.5.1 The EDTO certification is not granted permanently. It is submitted to a continued surveillance by the State of Design of the in-service reliability of the worldwide fleet of the concerned aircraft model/type.

1.5.2 The certified EDTO capability of the aircraft may therefore be reduced, suspended or even revoked if no solution exists to a major problem. This revisited EDTO capability should be reflected as applicable in relevant aircraft documentation.

1.5.3 Existing ETOPS certifications granted prior to the implementation of the new EDTO Standards in the State regulations remain valid and do not require recertification for EDTO. Refer to Section 2.2 for further information and guidelines on EDTO certification of aeroplanes with two turbine engines.

1.6 CONTINUITY OF EDTO AUTHORIZATION

1.6.1 The EDTO authorization is not granted permanently. It is submitted to a continued surveillance by the CAA of the operator's in-service reliability (concerning the EDTO fleet of aircraft).

1.6.2 The operator's procedures and training for EDTO are required to be maintained once an EDTO specific approval is issued.

1.6.3 Subject to 1.6.4, where an air operator ceases actual EDTO operations for a period exceeding a time determined by the CAA (e.g. 13 months), application for reinstatement should be submitted in accordance with Section 1.4.

1.6.4 Where an air operator ceases actual EDTO operation for a period exceeding the time defined in 1.6.3 but maintains simulated EDTO processes, procedures and training as prescribed in this manual, EDTO specific approval may be maintained until actual EDTO operation is resumed.

1.6.4.1 However, when actual EDTO operation resumes following a period of EDTO inactivity that exceeds the time defined in 1.6.3, recurrent training should be completed by each flight crew member before conducting EDTO operations as per the requirements stipulated by the CAA, and EDTO recurrent training should be completed by each flight dispatcher involved in EDTO operations and relevant maintenance and engineering staff as per those requirements.

1.6.5 Existing ETOPS authorizations granted prior to the implementation of the new EDTO Standards in the State regulations remain valid and do not require to be reauthorized for EDTO.

1.6.6 For minor revisions to EDTO/ETOPS authorizations, the authorization exercise should be focused on the requested changes to the programme. The intent is not to re-evaluate the entire approved programme unless warranted by reliability or operational concerns.

Chapter 2

AIRCRAFT AIRWORTHINESS CONSIDERATIONS FOR EDTO

2.1 BACKGROUND

2.1.1 In the context of this manual, the term "aircraft airworthiness considerations for EDTO" refers to the assessment for EDTO of the type design, reliability and maintenance programme of the concerned aircraft model (i.e. a given AEC) for EDTO. The aim of this assessment is to ensure that:

a) the design features are suitable for the intended EDTO operations. Equipment required for EDTO should be properly identified;

b) the reliability of relevant aircraft systems is suitable for the intended EDTO operations. Modifications to systems that may be necessary to achieve the desired level of reliability should be properly identified; and

c) the aircraft maintenance and reliability programmes can contribute to maintaining the desired level of reliability of relevant aircraft systems for EDTO. Special maintenance programme requirements for EDTO should be properly identified.

2.1.2 When ETOPS was initially introduced in 1985, the intent was to ensure that the level of safety of operations on extended diversion time routes (i.e. routes beyond 60 minutes from an alternate aerodrome) with twin-engine aeroplanes was consistent with the level of safety achieved with aeroplanes with more than two engines operated on the same routes. This was achieved through the implementation of the initial ETOPS requirements, which addressed both the authorization of the operator and the certification of the aeroplane.

2.1.3 EDTO is an evolution of ETOPS based on industry best practices and lessons learned during the first 25 years of ETOPS operations.

2.1.4 The airworthiness considerations for aeroplanes **with two turbine engines**, which include the identification of the time limitation of relevant TLSs, are therefore an evolution of the ETOPS criteria introduced in 1985, and are further detailed in Section 2.2.

2.1.5 The airworthiness considerations for aeroplanes **with more than two turbine engines** were discussed during the development of the EDTO criteria. In this context, a review was performed of the reliability of operations on extended diversion time routes with aeroplanes with more than two engines, and it was concluded that both the basic type certification standards and maintenance programme provided the required level of safety for EDTO and remained suitable for EDTO operations.

2.1.5.1 Accordingly, the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines. This means that for EDTO with Tris/Quads, there is no need for a review; both remain acceptable for EDTO operations.

2.1.5.2 Nevertheless, it was also concluded that a review of the limitation of relevant TLSs, if any, was necessary for aeroplanes with more than two engines engaged in EDTO. This specific airworthiness consideration for aeroplanes with more than two turbine engines is further detailed in Section 2.3.

2.2 AIRWORTHINESS CONSIDERATIONS FOR AEROPLANES WITH TWO TURBINE ENGINES

2.2.1 General

2.2.1.1 The EDTO certification of the aircraft is granted by the State of Design of the aircraft manufacturer. This EDTO certification may also be called EDTO type design and reliability approval of the aircraft.

2.2.1.2 The EDTO certification of the aircraft is a prerequisite to the start of EDTO operations (see Chapter 3). This EDTO certification therefore has to be validated or accepted by the CAA of the operator before the intended start of EDTO (see 1.4.2).

2.2.1.3 The EDTO certification is always granted to a given AEC. It is not granted indefinitely and is subject to continued surveillance by the State of Design of the in-service reliability of the worldwide fleet of the concerned aeroplane/engine combination (see 1.5).

Note 1.— ETOPS certifications granted before issuance or implementation of the new EDTO criteria remain valid (see 1.5.3).

Note 2.— EDTO certification may be called ETOPS certification in some documents as the term "ETOPS" may still be used instead of "EDTO" (see Foreword, Note concerning the use of the terms EDTO vs ETOPS).

2.2.1.4 Annex 6, Part I, Section 4.7, provides the basic requirements for the authorization of EDTO operations and the requirement for a specific approval. Attachment C to Annex 6 contains guidance on the setting of a threshold time, maximum diversion time and the means of achieving the required level of safety.

2.2.1.5 Section 2.2.2 provides further information on the EDTO certification requirements. Nevertheless, the EDTO certification criteria are detailed in Chapter 5 of the *Airworthiness Manual* (Doc 9760), which contains the airworthiness requirements for EDTO, and in particular guidance on the continuing airworthiness and airworthiness approval for aeroplanes with two turbine engines (except Section 5.2 which is dedicated to the considerations for aeroplanes with more than two turbine engines). They are therefore not repeated in this manual.

2.2.1.6 The certified EDTO capability of the aeroplane is reflected in the type certificate data sheet (TCDS), the aircraft flight manual (AFM) or AFM EDTO supplement, as applicable, and the EDTO CMP document.

2.2.1.7 The EDTO certification of the aircraft granted by the State of Design should then be validated or accepted by the State of Registry and, if different, the State of the Operator prior to the intended start of EDTO operations by the operator.

2.2.2 EDTO certification of aeroplanes with two turbine engines

2.2.2.1 ***Basic concept***

2.2.2.1.1 The basic concept of the EDTO certification, as for EDTO authorization, is to prevent the diversion to occur and to protect the safety of the aircraft should the diversion occur. Accordingly, the main intent of the EDTO certification requirements is to introduce:

a) reliability objectives, to minimize the occurrence of failures that could lead to a diversion; and

b) design features to retain a high level of systems performance.

2.2.2.2 ***EDTO design and reliability assessment***

2.2.2.2.1 The EDTO certification of an aircraft is an assessment of compliance of the candidate aircraft with all the design provisions and reliability objectives of the applicable EDTO certification criteria (e.g., EASA CS25.1535 or FAA 14CFR 25.1535).

2.2.2.2.2 A determination should be made that the design features for a new transport category type design with two turbine engines intended to be used in EDTO are suitable for such operations. In the event that an existing aeroplane's operation is expanded to include EDTO operations, dedicated evaluation of some design features may be necessary.

2.2.2.2.3 Modifications to some systems may be required to achieve the desired reliability or system performance. In particular, the EDTO significant systems for the particular AEC should be shown to be designed to fail-safe criteria and to have achieved a level of reliability suitable for the intended operation of the aeroplane (see 2.2.3).

2.2.2.3 ***EDTO configuration, maintenance and procedures (CMP) document***

2.2.2.3.1 The EDTO certification is reflected by the issuance of an EDTO CMP document. The EDTO CMP document gathers the required CMP and dispatch standards. For EDTO operations, the aircraft should be configured, maintained and operated according to the EDTO CMP document requirements.

2.2.2.3.2 The EDTO CMP document is approved by the State of Design. It is issued for the initial EDTO certification. It may be revised to reflect the conclusions of the in-service experience review (reliability surveillance performed by the State of Design). Refer to Section 2.2.5 for further information on continued validity of EDTO certification.

2.2.2.4 ***Master minimum equipment list (MMEL)/minimum equipment list (MEL) for EDTO***

Many airworthiness considerations for flight dispatch may already be incorporated into approved programmes for other aeroplanes or non-EDTO. The nature of EDTO necessitates a re-examination of these programmes to ensure that they are adequate for this purpose. System redundancy levels appropriate to EDTO should be reflected in the MMEL. An air operator's MEL may be more restrictive than the MMEL considering the kind of EDTO proposed and equipment and service problems unique to the operator.

2.2.2.5 ***Aircraft maintenance programme for EDTO***

2.2.2.5.1 In the context of the EDTO certification, a review of the aircraft maintenance programme should be performed to confirm that it adequately supports the targeted EDTO operations. This review should address the scheduled and unscheduled maintenance tasks, as well as the pre-departure service checks (preflight, transit, daily and weekly checks, as applicable).

2.2.2.5.2 The maintenance tasks related to EDTO should be identified, in order to clarify when a given task has to be performed and/or released by an EDTO qualified technician. These tasks should be related to the EDTO significant systems identified for the applicable aeroplane engine configuration (see Chapter 4).

2.2.2.5.3 The maintenance tasks related to EDTO are tasks impacting EDTO significant system(s). In other words, tasks which are not impacting any EDTO significant system(s) should not be considered as EDTO-related tasks.

2.2.2.5.4 If needed, the EDTO-related tasks may be further categorized as follows:

EDTO specific task

This is any task that is uniquely required when the aircraft is operated on EDTO and identified in the associated CMP document.

These tasks may originate from either a specific:

a) aircraft configuration mandatory for EDTO, e.g. cargo fire protection system with increased protection time; or

b) constraint related to the EDTO mission profile, e.g. increased flight duration, maximum EDTO diversion time (up to 180 minutes and beyond, etc.); or

c) MMEL constraint for EDTO (e.g. SATCOM inoperative is a no-go item for EDTO beyond 180 minutes).

These tasks and the related interval (defined through above relevant maintenance and/or safety analyses) should be listed in the EDTO CMP document.

The operator should ensure that these tasks are revised in their approved maintenance programme and scheduled and performed in accordance with the applicable interval. In case of mixed EDTO/non-EDTO operations, compliance with the EDTO interval is required.

Note 1.— In the context above, "mixed EDTO/non-EDTO operations" means the same aircraft (or fleet of aircraft) is continuously operated on both EDTO and non-EDTO flights.

Note 2.— In case of "mixed EDTO/non-EDTO operations", any tasks to be performed prior to an EDTO flight (e.g. tasks from the EDTO pre-departure service check) are not required to be performed before the non-EDTO flights.

EDTO relevant task

This is any task (other than EDTO specific task) impacting an EDTO significant system and addressing:

a) an EDTO significant functional failure; or

b) a reliability constraint with system/component design and requiring a different interval than the one quoted in the basic (non-EDTO) maintenance planning document (MPD) for the task to support EDTO operations.

These tasks may be identified as EDTO relevant tasks to restore and/or maintain the reliability levels required for EDTO. These tasks may be listed in the EDTO CMP document.

The operator should ensure that dual maintenance (scheduled or unscheduled) on identical (or substantially similar) EDTO significant systems during the same maintenance visit is to be specifically managed by the operator-approved EDTO/ETOPS programme (see Chapter 4). This is to preclude common cause human failure modes.

2.2.2.6 ***Issuance of EDTO certification***

2.2.2.6.1 Upon satisfactory completion of an engineering type design review and test programme, which may include certification flight test evaluation or other dedicated bench test and analyses, an EDTO certification (type design and reliability approval) is issued. The AFM or AFM EDTO supplement, as applicable, the EDTO CMP document and TCDS, or any other relevant manufacturer documentation or tools, should contain the following information as applicable:

a) special limitations, including any limitations associated with operation of the aeroplane up to the maximum EDTO capability being approved;

b) the airborne equipment, installation and flight crew procedures required for EDTO operations;

c) EDTO performance information including fuel consumption rates;

d) markings or placards;

e) the maximum diversion time capability of the aeroplane for EDTO as well as the time capability of the TLSs, e.g. the most limiting fire suppression system for Class C cargo or baggage compartments and the most limiting EDTO significant system other than fire suppression systems (see 2.2.4); and

f) the following or similar statement: "The type design, reliability and performance of this aeroplane/engine combination has been evaluated in accordance with the [*state* applicable EDTO certification criteria] and found suitable for [*state* maximum approved diversion time] EDTO operations when the configuration, maintenance, and procedures standards contained in [*identify* the applicable approved EDTO CMP document] are met. The actual maximum approved diversion time for this aeroplane may be less, based on its most limiting system time capability or other applicable limitation. This finding does not constitute an authorization to conduct EDTO."

2.2.2.6.2 Section 4.10 provides further guidelines and examples on how the above data may be included in the relevant manuals, documents and tools.

2.2.3 EDTO significant systems

2.2.3.1 An EDTO significant system is a system whose failure or degradation could adversely affect the safety of an EDTO flight or whose continued functioning is important to the safe flight and landing of an aeroplane during an EDTO diversion. Such systems include:

a) electrical systems, including battery (if relevant);

b) hydraulics;

c) pneumatic systems;

d) flight instrumentation;

e) fuel systems;

f) flight controls;

g) ice protection systems;

h) engine start and ignition;

i) engine system instruments;

j) navigation and communications;

k) engines;

l) auxiliary power units;

m) air conditioning and pressurization;

n) cargo fire suppression;

o) engine fire protection;

p) emergency equipment; and

q) any other equipment required for EDTO.

2.2.3.2 EDTO/ETOPS significant systems are identified to support EDTO/ETOPS design standards as well as support the acceptance of maintenance and operational procedures.

2.2.3.3 State regulations may require further classification of each EDTO significant system into either a Group 1 or a Group 2 system as follows:

a) an EDTO significant system is classified in Group 1 when its importance for EDTO relates to the number of engines of the aeroplane. Under this principle, this category contains the EDTO significant systems that are specifically more important for the safety of EDTO operations of two-engine aircraft; and

b) an EDTO significant system is classified in Group 2 when its importance for EDTO is the same for two-, three- and four-engine aircraft.

2.2.3.4 The identification of EDTO Group 1 systems is done through the assessment of the consequence of an engine failure. Therefore, these Group 1 systems are typically more relevant to twin-engine aeroplanes compared to four-engine aeroplanes.

2.2.3.5 Group 2 systems, which are typically common to two-, three- and four-engine aircraft, are not affected by these additional requirements related to reliability demonstration because it is considered that the basic type certification adequately covers the need. Nevertheless, the consequence of failure of such a system would still require to be addressed in the frame of the reliability (and maturity) demonstration for EDTO, and any required corrective action could be mandated further to an assessment of the impact of the concerned system failure on the safety of the flight.

2.2.3.6 This classification is only necessary for the aircraft manufacturer when conducting the EDTO reliability demonstration under the early EDTO certification method in the context of aircraft certification activities, as additional requirements apply to Group 1 systems. The objective of the early EDTO demonstration is to validate the reliability of the aeroplane at entry into service, in accordance with the early EDTO certification process. This demonstration of reliability is required only for the EDTO Group 1 systems.

2.2.3.7 It is important to note that the Group 1 and Group 2 EDTO significant systems should be equally considered by the EDTO operator. In other words, this distinction is not needed in the context of EDTO operations and should not lead to a different consideration and treatment of Group 1 and Group 2 systems by the EDTO operator.

2.2.4 Time-limited systems (TLSs)

2.2.4.1 As per the EDTO certification criteria, the time capability of the cargo fire suppression system (for cargo or baggage compartments) and the other most time-limiting EDTO significant system must be demonstrated.

Note 1.— For aeroplanes with no time-limited EDTO significant system (other than the cargo fire suppression system), the value of "the other most limiting EDTO significant system" corresponds to the maximum diversion time assumptions taken in the safety analyses. In other words, there is no identified system, and this limitation therefore applies to all systems other than the cargo fire protection system.

Note 2.— The requirement to determine the time capability of "the other most limiting EDTO significant system" has been introduced by the new EDTO criteria. As explained in Section 2.2.1, the ETOPS certifications granted before issuance or implementation of the new EDTO criteria remain valid. Therefore, for these ETOPS certifications, the time capability of "the other most limiting EDTO significant system" is not provided, and it is considered to be no less than the approved ETOPS (or EDTO) maximum diversion time capability of the concerned aircraft.

2.2.4.2 The time capability of the TLSs (i.e. the most limiting fire suppression system and the most limiting EDTO significant system other than the fire suppression system) are recorded in the AFM or AFM EDTO supplement, as applicable, the EDTO CMP document and TCDS, or in any other relevant manufacturer documentation or tools.

2.2.4.3 The time capability of the TLSs has to be adequately considered in the operational dispatch of the aircraft. Refer to Chapter 3 for detailed guidelines on the consideration of the TLSs versus the maximum diversion time for the dispatch of the aircraft on EDTO routes.

2.2.5 Continued validity of EDTO certification (airworthiness monitoring)

2.2.5.1 As explained in Section 1.5, the EDTO certification is not granted permanently. It is subject to continued surveillance by the State of Design of the in-service reliability of the worldwide fleet of the concerned aircraft model/type. This reliability surveillance may result in changes to the EDTO standards for the airframe or engines (i.e. service bulletins issued by the aeroplane manufacturer, maintenance or procedures mandated to restore the reliability).

Note.— Existing ETOPS certifications granted prior to the implementation of the new EDTO Standards in the State regulations remain valid and do not require recertification for EDTO.

2.2.5.2 These modifications/service bulletins, maintenance tasks or procedures necessary to restore the reliability may therefore be mandated through a new issue of the EDTO CMP document and/or dedicated mandatory continuing airworthiness information (MCAI).

2.2.5.3 The certified EDTO capability of the aircraft may therefore be reduced, suspended or even revoked if no solution exists to a major problem. This revised EDTO capability should be reflected as applicable in dedicated revision of the TCDS, AFM (or AFM EDTO supplement, as applicable) and EDTO CMP document (and/or through dedicated MCAI). EDTO operations of the concerned aircraft should not be performed beyond the revised EDTO capability.

2.3 AIRWORTHINESS CONSIDERATIONS FOR AEROPLANES WITH MORE THAN TWO TURBINE ENGINES

2.3.1 General

2.3.1.1 As explained in Section 2.1, EDTO certification is not required for aeroplanes with more than two engines. This means that the configuration and maintenance standards defined through the basic type certification of an aeroplane with more than two engines are considered as adequate for EDTO operations.

2.3.1.2 Nevertheless, a review of the TLS, if any, on aeroplanes with more than two engines should be performed by the aircraft manufacturer. The objective of this review is to confirm whether these time limitations have to be considered for the dispatch of EDTO flights and if the corresponding time limitation should be provided in relevant aircraft documentation.

2.3.1.3 As explained in Section 2.1.5, there are no additional EDTO certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines. Notwithstanding that ICAO

Standards do not require EDTO certification for aeroplanes with more than two engines, a State may have implemented standards for EDTO (or ETOPS) certification of these aeroplanes. In this case:

a) existing ETOPS certifications granted prior to the implementation of the new EDTO Standards in the State regulations remain valid and do not require recertification for EDTO;

b) the EDTO certification is reflected by the issuance of an EDTO CMP document. The EDTO CMP document gathers the required configuration standards and maintenance tasks, and as applicable, the flight crew procedures and dispatch standards. For EDTO operations, the aircraft should be configured, maintained and operated according to the EDTO CMP document requirements; and

c) the EDTO CMP document is approved by the State of Design. It is issued for the initial EDTO certification. It may be revised to reflect the conclusions of the in-service experience review (reliability surveillance performed by the State of Design) through the airworthiness directive process. Refer to Section 2.2.5 for further information on continued validity of EDTO certification.

2.3.2 EDTO certification of aeroplanes with more than two turbine engines

The subject of EDTO certification is not applicable to aeroplanes with more than two engines, except as described in 2.3.1.3.

2.3.3 EDTO significant systems

EDTO significant systems are explained in Section 2.2.3. As there are typically no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines, the consideration of the EDTO significant system is only necessary for the identification of the time capability of the most time-limiting EDTO significant system.

2.3.4 Time-limited systems (TLSs)

2.3.4.1 The time capability of the most time-limiting EDTO significant system must be identified. In most cases, this most time-limiting EDTO significant system is the cargo fire suppression system (for cargo or baggage compartments).

2.3.4.2 The time capability of the most time-limiting EDTO significant system should be reflected in the relevant manufacturer documentation or tools.

2.3.4.3 The time capability of the most time-limiting EDTO significant system has to be adequately considered in the operational dispatch of the aircraft. Refer to Chapter 3 for detailed guidelines on the consideration of this TLS versus the maximum diversion time for the dispatch of the aircraft on EDTO routes.

2.3.5 Continued validity of EDTO certification (airworthiness monitoring)

2.3.5.1 The subject of continued validity of EDTO certification is not applicable to aeroplanes with more than two engines.

2.3.5.2 As explained in 2.1.5, there are typically no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines.

Chapter 3

EDTO FLIGHT OPERATIONS REQUIREMENTS

3.1 GENERAL

3.1.1 As explained in Section 1.4, in considering an application from an air operator to conduct EDTO operations, an assessment should be made of the air operator's overall safety record, past performance, flight crew training, flight dispatcher training, maintenance training and maintenance reliability programmes. The data provided with the request should substantiate the air operator's ability to safely conduct and support these operations and should include the means used to satisfy the criteria outlined in this section and in Chapter 4.

3.1.2 As detailed in Section 1.1, the operator should obtain from its CAA an EDTO authorization by specific approval before starting commercial operations of transport category aeroplanes over a specified route containing a point beyond the applicable EDTO threshold time.

Note 1.— Previously issued specific approvals for ETOPS programmes continue to be valid. Requests for new EDTO authorizations or changes to existing programmes will be assessed under the criteria outlined in this manual.

Note 2.— Minor revisions to existing approved ETOPS/EDTO programmes are addressed in 1.6.6.

3.1.3 The applicable EDTO threshold time has to be established by the State. It might not be the same for two-engine transport category aeroplanes and for transport category aeroplanes with more than two engines.

3.1.3.1 In establishing the EDTO threshold time for two-engine transport category aeroplanes, the State should consider that the maximum diversion time capability of two-engine transport category aeroplanes not certified for EDTO is usually limited to 60 minutes. Therefore, the threshold time for such EDTO operations should normally be set at 60 minutes. It is possible to select a greater threshold time value after a thorough assessment of the impact of such a value on non-EDTO operations by non-EDTO certified two-engine transport category aeroplanes.

3.1.3.2 In establishing the EDTO threshold time for transport category aeroplanes with more than two engines, the State should consider the specificities of such operations. Considering that the vast majority of long-range operations over the last 50 years have been conducted successfully within 180-minute maximum diversion time and were not subject to any specific criteria, the threshold time for such EDTO operations should normally be set at 180 minutes. It is possible to select another threshold time value after a thorough assessment of the impact of such value on existing operations and on the time limitations, if any, of transport category aeroplanes with more than two engines operated beyond the threshold time.

3.2 CONVERSION OF THRESHOLD AND MAXIMUM DIVERSION TIME INTO DISTANCE

3.2.1 General

3.2.1.1 In order to relate threshold and maximum diversion times to an area of geographic applicability, the time value of interest must be converted into an equivalent distance value which is typically expressed as a still-air (zero wind) range in nautical miles based on an assumed diversion speed schedule.

3.2.1.2 This distance value is then used to construct diversion radius arcs around en-route alternate aerodromes to establish the non-EDTO and EDTO areas of operation.

3.2.1.3 Guidance on performing the time-to-distance conversion is provided in Annex 6, Part I, Attachment C. The conversion calculation itself is typically performed using aeroplane manufacturer data derived from operational documents and software tools or from basic aerodynamic speed relationships, as appropriate.

3.2.1.4 It should be noted that the 60-minute (non-EDTO) and EDTO areas of operation are defined in international standard atmosphere (ISA) and still-air (zero wind) conditions. Therefore, actual diversion times may be higher than the diversion times used to establish the corresponding area of operation. This is expected and does not constitute an area of operation exceedance as long as the planned route of flight remains within the applicable still-air range from an en-route alternate aerodrome.

3.2.1.5 The basic concepts of still-air diversion distance and area of operation are common to two-engine aeroplanes and to aeroplanes with more than two engines; however, the assumed flight conditions under which these assessments are performed differ as described in the following sections. It should also be noted that the diversion speed/distance assessment is typically applied to a particular geographic area and AEC, and may vary for different fleets and regions. Also, the speed used to calculate the EDTO threshold distances for a particular operation may be different than the speed used to determine the EDTO maximum diversion distance.

3.2.2 Determining the applicable threshold/diversion distances — aeroplanes with two engines

3.2.2.1 The time-to-distance conversion for two-engine aeroplanes is performed using an operator-selected one-engine-inoperative (OEI) speed which must be within the certified operational envelope of the candidate aeroplane. This calculation is by convention typically based on a still-air standard day thrust limited driftdown profile starting from normal cruise altitude at an assumed reference mass with maximum continuous thrust set on the remaining operating engine after the point of engine failure.

3.2.2.2 The OEI speed schedule is normally represented as a Mach/IAS (indicated airspeed) combination with constant Mach targeted during the initial portion of the driftdown profile followed by constant IAS after the aeroplane passes through the Mach/IAS transition altitude as illustrated in Figure 3.2-1.

3.2.2.3 Operators applying for EDTO authorization should include justification for their selected OEI speed schedule and diversion distance calculation with their EDTO authorization application.

3.2.2.4 Typical justification would consist of supporting manufacturer data derived from operational documents and/or software tools. Additional justification may include relevant operator performance calculations and flight planning system implementation. Table 3-1 is a typical example of manufacturer diversion distance information for operational planning and justification (data formats may vary).

3.2.2.5 The time-to-distance conversion for two-engine aeroplanes is sometimes, but not normally, based on a constant true airspeed (TAS) assumption instead of the more typical Mach/IAS OEI speed schedule described above, due to local regulation variations or limitations in operator flight planning systems.

3.2.2.6 While the constant TAS method may have been used in some legacy EDTO programmes, industry standards have evolved to the more typical driftdown calculation based on Mach/IAS speed parameters which can actually be targeted by the flight crew. The relationship between time and distance is non-linear with this calculation approach due to the variation in altitude with time during the thrust limited driftdown portion of the engine failure profile.

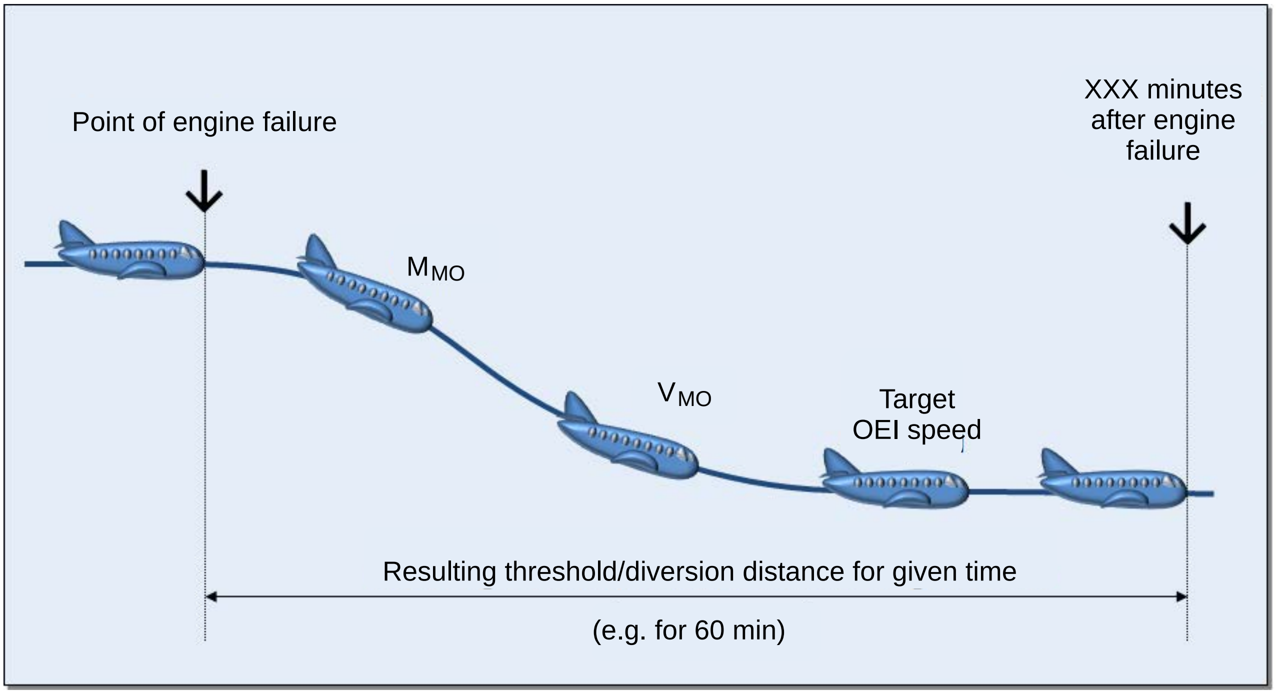

Figure 3.2-1. Driftdown profile example: Max OEI speed / Max continuous thrust (MCT)

Table 3-1. Example EDTO diversion distance information

MAXIMUM DIVERSION DISTANCE							
Speed schedule	*A/C mass at critical point (x 1 000 kg)*	*FL for diversion*	*Diversion time (Min)*				
			60	*120*	*180*	*300*	*370*
MCT/330KT	170	190	439	866	1294		
	190	180	436	860	1285	2136	2500
	210	170	434	853	1272	2110	2500
	230	160	431	844	1257	2083	2500
	250	150	427	834	1241	2056	2500
	270	140	422	823	1225	2027	2496
MCT/300KT	170	220	424	837	1249		
	190	220	424	836	1249	2073	2500
	210	220	419	827	1238	2062	2500
	230	210	415	818	1224	2036	2500
	250	190	412	806	1200	1988	2448
	270	180	407	795	1184	1960	2413

3.2.2.7 ***Sixty-minute threshold***

The 60-minute threshold distance calculation is used to determine whether the Standards for two-engine aeroplanes set forth in Section 4.7.1 of Annex 6, Part I, are applicable. The calculation is normally based on a high engine inoperative speed up to the maximum permissible operating speed or Mach number (VMO/MMO) in order to maximize the 60-minute area of operation.

3.2.2.8 ***EDTO threshold***

The EDTO threshold distance calculation is used to determine whether the Standards set forth in Section 4.7.2 of Annex 6, Part I, are applicable. This calculation is also used to determine the EDTO entry and exit points in an EDTO operational area. Typically, the calculation is based on a 60-minute diversion time as in 3.2.2.7; however, a different time value may be used if a State has chosen to set its EDTO threshold time to something other than 60 minutes.

Note.— The EDTO threshold distance calculation will be common to the 60-minute threshold distance calculation for a given region and aeroplane type if a State has chosen to set 60 minutes as the EDTO threshold for two-engine aeroplanes.

3.2.2.9 ***EDTO maximum diversion distance***

3.2.2.9.1 The EDTO maximum diversion distance calculation for two-engine aeroplanes is required if an operation has been determined to have a need to exceed the geographic area constraints defined by the EDTO threshold distance (normally the distance associated with 60 minutes).

3.2.2.9.2 The time-to-distance conversion is performed at the operator's approved or proposed OEI cruise speed and maximum EDTO diversion time for a particular aeroplane type (AEC) and operational area. This defines the maximum still-air radius that a flight can be from an en-route alternate aerodrome. These computations are typically performed considering a relatively high OEI speed to maximize the EDTO area of operations; however, other considerations such as diversion fuel requirements may dictate a lower speed selection. The selected EDTO OEI speed schedule also has implications on EDTO diversion fuel planning which is discussed in Section 3.5.3.

3.2.2.9.3 For EDTO operations, the threshold and maximum diversion distance calculations should normally be based on the same OEI speed schedule.

3.2.3 Determining the applicable threshold/diversion distances — aeroplanes with more than two engines

3.2.3.1 For aeroplanes with more than two engines, the speed used to convert the 60-minute, EDTO thresholds and EDTO maximum diversion times to corresponding diversion distance values is not an OEI speed as for two-engine aeroplanes, but rather an assumed all-engine cruise speed which is selected by the operator based on the performance characteristics of the particular AEC. As with two-engine aeroplanes, the selected speed must be within the aeroplane's certified operational flight envelope, and thus, must be less than or equal to the maximum operational speed (MMO and/or VMO) defined in the AFM or other relevant documentation or tool(s) from the aeroplane manufacturer.

3.2.3.2 The selected all-engine cruise speed used to calculate the applicable distances for aeroplanes with more than two engines does not have any fuel planning implications, so typically the highest possible speed may be used to maximize the corresponding operational area. EDTO diversion fuel planning is discussed in Section 3.5.3.

3.2.3.3 Further, the most favourable cruise altitude may be used in the calculation since altitude capability constraints are not a factor. For a given selected all-engine cruise speed and altitude, the time-to-distance relationship for aeroplanes with more than two engines is essentially a TAS conversion based on standard aerodynamic relationships and therefore the aeroplane/engine specific manufacturer diversion distance information is not required.

3.2.3.4 Operators applying for EDTO authorization should include justification for their selected all-engine cruise speed with their EDTO authorization application. Typical justification would consist of supporting performance calculations and manufacturer data derived from operational documents or software tools. Additional justification may include details on flight planning system implementation.

Note.— Some national regulations may specify an OEI cruise speed as opposed to an all-engine cruise speed for establishing the applicable distances for aeroplanes with more than two engines. In this case, the time-to-distance conversion is comparable to the two-engine aeroplane methodology described in Section 3.2.2 except that the thrust limited altitude profile after the point of engine failure will typically be much higher than for a two-engine aeroplane.

3.2.3.5 ***Sixty-minute threshold***

The 60-minute threshold distance calculation is used to determine whether the Standards for aeroplanes with more than two engines set forth in Section 4.7.1 of Annex 6, Part I, are applicable. The calculation is normally based on a high all-engine cruise speed up to MMO/VMO in order to maximize the 60-minute area of operation.

3.2.3.6 ***EDTO threshold***

The EDTO threshold distance calculation is used to determine whether the Standards set forth in Section 4.7.2 of Annex 6, Part I, are applicable. This calculation is also used to determine the EDTO entry and exit points in an EDTO operational area. Typically, the calculation is based on a 180-minute diversion time unless the individual State has elected to specify a different EDTO threshold time for aeroplanes with more than two engines.

3.2.3.7 ***EDTO maximum diversion distance***

3.2.3.7.1 The EDTO maximum diversion distance calculation for aeroplanes with more than two engines is required if an operation has been determined to have a need to exceed the geographic area constraints defined by the EDTO threshold distance (normally the distance associated with 180 minutes). The time-to-distance conversion is performed at the operator’s approved or proposed all-engine cruise speed and maximum EDTO diversion time for a particular aeroplane type (AEC) and operational area, and defines the maximum still-air radius that a flight can be from an en-route alternate aerodrome. As with the 60-minute and EDTO threshold distance calculations, the highest available all-engine cruise speed and most favourable altitude are generally used for this calculation to maximize the operational area, although some operators may choose to use different speed and altitude assumptions.

3.2.3.7.2 For EDTO operations, the threshold and maximum diversion distance calculations should normally be based on the same AEO speed schedule.

3.3 OPERATIONS BEYOND 60 MINUTES

3.3.1 Operations beyond 60 minutes from an en-route alternate aerodrome should incorporate the Standards set forth in Section 4.7.1 of Annex 6, Part I. These operations may involve an EDTO authorization, depending upon:

a) the applicable EDTO threshold times that have been established by the State of the Operator; and

b) the maximum diversion time used by the operator for the operations.

3.3.2 For two-engine aeroplanes, many States have established a 60-minute EDTO threshold, therefore operations beyond 60 minutes would also constitute an EDTO operation. For aeroplanes with more than two engines, EDTO diversion time thresholds established by States are typically much higher than 60 minutes (e.g. 180 minutes) and therefore an operation beyond 60 minutes would not involve EDTO authorization, unless that operation is conducted beyond the State established EDTO threshold time.

3.3.3 Regardless of whether EDTO is involved, all operations beyond 60 minutes from an en-route alternate aerodrome should incorporate suitable operational control and flight dispatch procedures, operating procedures and training programmes to support the operation. A specific approval is not required for these operations if they are not conducted beyond the applicable EDTO threshold; however, approved operating manuals and procedures should include the appropriate considerations as outlined in this section. Additional guidance on beyond 60-minute operations may also be found in Annex 6, Part I, Attachment C.

Note.— The determination of whether an operation is beyond 60 minutes from an en-route alternate aerodrome is based on the time-to-distance conversion methodology outlined in Section 3.2.2 for two-engine aeroplanes and Section 3.2.3 for aeroplanes with more than two engines.

3.3.4 En-route alternate aerodrome considerations — two-engine aeroplanes

3.3.4.1 En-route alternate aerodromes are aerodromes to which an aeroplane may proceed in the event that a diversion becomes necessary while en-route, where the necessary services and facilities are available, where aircraft performance requirements can be met and which are expected to be operational if required. Take-off and/or destination aerodromes may also be designated as en-route alternate aerodromes.

3.3.4.2 All operations beyond 60 minutes should include the identification of en-route alternate aerodromes in the dispatch process. The operational status of these aerodromes including meteorological conditions should be evaluated and the most up-to-date available information provided to the flight crew prior to departure. The flight crew should also have a means to obtain en-route alternate aerodrome weather updates as required during the flight.

3.3.4.3 The en-route alternate aerodrome assessment (irrespective of EDTO) should ensure that the forecast conditions at identified aerodromes will be at, or above, the operator's established aerodrome operating minima at the estimated time of use.

3.3.4.4 Additional considerations for EDTO alternate aerodromes are discussed in Section 3.5.2. These additional EDTO considerations are relevant to operations beyond 60 minutes if the State has established a 60-minute EDTO threshold for these operations.

3.3.5 En-route alternate aerodrome considerations — aeroplanes with more than two engines

3.3.5.1 En-route alternate aerodromes are aerodromes to which an aeroplane may proceed in the event that a diversion becomes necessary while en-route, where the necessary services and facilities are available, where aircraft performance requirements can be met and which are expected to be operational if required. Take-off and/or destination aerodromes may also be designated as en-route alternate aerodromes.

3.3.5.2 All operations beyond 60 minutes should include the identification of en-route alternate aerodromes in the dispatch process. The operational status of these aerodromes including meteorological conditions should be evaluated and the most up-to-date available information provided to the flight crew prior to departure. The flight crew should also have a means to obtain en-route alternate aerodrome weather updates as required during the flight.

3.3.5.3 There is no specific requirement that weather conditions at identified en-route alternate aerodromes are forecast to be at, or above, the operator's established aerodrome operating minima.

3.4 OPERATIONS BEYOND EDTO THRESHOLD TIME CONSIDERATIONS

Operations beyond the State-established EDTO threshold time for the applicable aeroplane type require an EDTO specific approval and should incorporate the Standards set forth in Section 4.7.2 of Annex 6, Part I. Specific considerations for maximum diversion time authorization levels appropriate to two-engine aeroplanes and to aeroplanes with more than two engines are addressed in this section.

3.4.1 Approval levels — EDTO operations with two-engine aeroplanes

3.4.1.1 The EDTO operational approval level granted to an applicant should be consistent with the operational need (route requirements), the aeroplane EDTO capability, relevant operational experience and robustness of the operator's EDTO programme compliance. All EDTO authorizations require the operator to implement supporting flight operations and maintenance programmes as discussed in this chapter and in Chapter 4, respectively. These programmes should address continuing airworthiness, release considerations including weather and MEL, flight planning, training, en-route alternate aerodromes and communication capability.

3.4.1.2 The operational EDTO programmes, in general, contain the same basic elements regardless of the EDTO diversion time authorization, but should be tailored as applicable to the relevant level of approved diversion time.

3.4.1.3 The following major EDTO diversion time categories are typical of State regulations; however, some States may have different or additional diversion time categories identified in local regulations.

3.4.1.4 ***Up to 90-minute authorization***

3.4.1.4.1 EDTO authorizations up to 90 minutes are generally associated with benign operational areas where higher diversion times are not required to support direct routing. In this case, some relaxation in the operational programme requirements relative to higher EDTO times may be implemented in local regulations.

3.4.1.4.2 For instance, if the AEC does not have an EDTO certification for at least 90 minutes diversion time, the aircraft design features and reliability should be assessed versus the relevant EDTO design requirements. This assessment should confirm the suitability of the aircraft for such operations without requiring a formal EDTO certification.

3.4.1.4.3 Consideration may be given to the authorization of EDTO up to 90 minutes for operators with minimal or no in-service experience with the AEC. This determination considers such factors as the proposed area of operations, the operator's demonstrated ability to successfully introduce aeroplanes into operations, and the quality of the proposed continuing airworthiness and operations programmes.

3.4.1.4.4 Minimum equipment list (MEL) restrictions for 120 minutes EDTO should be used if available, unless there are specific restrictions for 90 minutes or less.

Note.— Some States have implemented specific requirements for 75-minute EDTO maximum diversion time. Refer to operating regulations of the State of the Operator.

3.4.1.5 ***Beyond 90-minute and up to 180-minute authorization***

3.4.1.5.1 EDTO authorizations up to 180 minutes support most EDTO operational areas and reflect the vast majority of worldwide EDTO operations. It may therefore be expected that the vast majority of operator approval applications will fall into this category.

3.4.1.5.2 The AEC must be approved for EDTO in the type certification up to at least the maximum diversion time being requested (e.g. 120, 180 minutes).

3.4.1.5.3 The operator must comply with the MEL requirements appropriate to the approved maximum diversion time (e.g. 120 minute EDTO and beyond). The operator's MEL cannot be less restrictive that the MMEL appropriate to the approved maximum diversion time.

3.4.1.6 ***Fifteen per cent diversion time authorization increases***

3.4.1.6.1 If the certified EDTO capability of the aeroplane is 120- or 180-minute maximum diversion time, an operator may request an increase in the operator's approved diversion time for specific routes or on an exceptional basis provided:

a) the requested operator's approved diversion time does not exceed:

   1) 115 per cent of the certified maximum diversion time capability of the aeroplane for EDTO; and

   2) the capability of the most limiting EDTO significant system other than fire suppression systems minus 15 minutes;

b) the operator's dispatch process (fuel calculation, MEL, etc.) supports the resulting increased diversion time; and

c) such increases may require an assessment of the overall type design including TLSs and demonstrated reliability if the certified EDTO capability of the aeroplane is less than the contemplated increased diversion time.

Note.— Some States have established specific maximum diversion time categories of 138- and 207-minute EDTO, which equate to 15 per cent increases from 120- and 180-minute EDTO, respectively. In this application, 207 minutes is not considered beyond 180 minutes EDTO, but rather an operational extension to 180-minute EDTO authority. Refer to operating regulations of the State of the Operator.

3.4.1.7 ***Beyond 180-minute authorization***

3.4.1.7.1 Beyond 180-minute maximum diversion time, authorization may be required for direct routing in some operational areas based on limited availability of en-route alternate aerodromes, or to manage day-of-flight operational exceptions. These may include, for instance, the North Pacific areas as well as routes which traverse the southern oceanic regions.

3.4.1.7.2 Authorization to conduct operations with diversion times exceeding 180 minutes may be granted to operators with previous EDTO experience and an existing 180-minute EDTO authorization on the AEC listed in their application (see 1.4.2). The authorization by specific approval to operate EDTO by more than 180 minutes may be area-specific, based on the availability of en-route alternate aerodromes in the operational area.

Note.— Some States have established specific "beyond 180-minute" EDTO maximum diversion time authorization categories for 240 minutes and beyond. Refer to operating regulations of the State of the Operator.

3.4.1.7.3 In view of the long diversion time involved (above 180 minutes), the operator is responsible to ensure at the flight planning stage, that on any given day in the forecast conditions (such as prevailing winds, temperature and applicable diversion speed), a diversion to an en-route alternate aerodrome will not exceed the capability of:

a) the most limiting EDTO significant system other than fire suppression systems minus 15 minutes at the approved OEI cruise speed; and

b) the cargo fire suppression system minus 15 minutes, at the AEO cruise speed.

3.4.2 Authorization levels — EDTO operations with aeroplanes with more than two engines

3.4.2.1 ***Operations up to 180 minutes***

Operations up to 180 minutes diversion time from an en-route alternate aerodrome by aeroplanes with more than two engines do not typically require an EDTO authorization since most States have established an EDTO threshold time of 180 minutes for these operations. If the State has established a lower EDTO threshold time than 180 minutes, an EDTO specific approval may be required depending upon the maximum diversion time required for the operation.

Note.— The determination of whether an operation is within 180 minutes or the applicable threshold time from an en-route alternate aerodrome is based on the time-to-distance conversion methodology outlined in Section 3.2.2.

3.4.2.2 ***Beyond 180-minute authorization***

3.4.2.2.1 EDTO authorization is typically required for aeroplanes with more than two engines if the intended operation exceeds 180 minutes diversion time from an en-route alternate aerodrome, barring exceptions where a different EDTO time threshold has been established by the State of the Operator. There are no specific maximum diversion time authorization levels other than to allow operations beyond the applicable threshold time; rather it is the EDTO TLS capability of the particular aeroplane which establishes the basis for diversion time planning to an en-route alternate aerodrome. The EDTO TLS is typically determined by the cargo fire suppression system capacity unless another EDTO system time limitation has been specified by the aeroplane manufacturer (see 2.3.4). Operational planning considerations as relate to EDTO TLSs are addressed in Section 3.5.

3.4.2.2.2 As with two-engine aeroplanes, EDTO authorizations for aeroplanes with more than two engines require the operator to implement a supporting flight operations programme. This programme should address release considerations including weather and MEL, flight planning, training, en-route alternate aerodromes and communication capability (see 3.5).

3.4.2.2.3 EDTO authorizations for aeroplanes with more than two engines do not, however, require an EDTO certification (see 2.3.1.3). Further, EDTO maintenance procedures or EDTO maintenance programme requirements are not applicable to aeroplanes with more than two engines as discussed in Section 4.1.1.

3.4.3 Polar operations

3.4.3.1 Polar operations are not specifically addressed in the ICAO Annex 6 Standards or related guidance materials; however, some States have established additional requirements for authorization of these operations for which EDTO considerations may also be applicable.

3.4.3.2 Unlike EDTO which is based on a diversion time/distance threshold from an en-route alternate aerodrome, polar operations, where applicable, are defined by a latitude threshold such that if the route of flight goes beyond the defined latitude, it is considered a polar operation. States which have elected to implement these requirements have typically defined 78°N and 60°S as the latitude thresholds for north and south polar operations, respectively. Polar operational requirements are dictated by the additional challenges of conducting flight operations in these remote environments and may typically include en-route alternate aerodrome considerations, communication capability, fuel freeze avoidance strategies, solar flare monitoring and additional training. Refer to the operating regulations from the State of the Operator where implemented for specific information.

3.4.3.3 Polar operations may also involve EDTO depending on the type of aeroplane and the applicable EDTO threshold times established by the State of the Operator. In such cases, both polar and EDTO authorizations are required to support the operation. Typically a north polar operation would also be considered an EDTO operation for two-engine aeroplanes based on a 60-minute EDTO threshold, while aeroplanes with more than two engines using a 180-minute threshold time would not be considered EDTO. South polar operations, on the other hand, may require EDTO authorization as concerned routes are typically beyond 180-minute diversion time for both two-engine aeroplanes and aeroplanes with more than two engines.

3.4.3.4 The determination of whether EDTO is required to support a particular polar operation is based on the following factors:

a) the contemplated polar routes and en-route alternate aerodromes;

b) the type of aeroplane and applicable diversion time threshold established by the State of the Operator; and

c) the EDTO threshold time-to-distance conversion as outlined in Section 3.2.

3.4.3.5 It should be noted that polar operations authorization is not relevant if a State has not established specific requirements for polar operations; however, EDTO authorization may be a factor for these polar operational areas based on the above-listed considerations.

3.5 FLIGHT PREPARATION CONSIDERATIONS

The flight preparation considerations discussed in this section are in addition to, or to amplify, the standard operating requirements contained in applicable State regulations and specifically apply to EDTO operations. Although many of the following criteria may be incorporated into approved programmes for non-EDTO aeroplanes or route structures, the nature of EDTO necessitates that compliance with these criteria be re-examined to ensure that approved programmes are adequate for the intended EDTO operations.

3.5.1 EDTO area of operations

3.5.1.1 ***General***

3.5.1.1.1 Following satisfactory compliance with the criteria outlined in this section, an air operator may be authorized to conduct EDTO with a particular AEC within a particular area of operation. The EDTO area of operation is limited by the maximum approved diversion time to an en-route alternate aerodrome at the approved diversion speed (under ISA conditions in still-air) from any point along the proposed route of flight.

3.5.1.1.2 The EDTO area of operations is established during the flight preparation process based on the designated en-route alternate aerodromes (Section 3.5.2) and the maximum diversion distance corresponding to the approved

EDTO maximum diversion time and speed (Sections 3.2.3.7 and 3.2.2.9). This area is typically represented graphically by maximum diversion distance arcs or circles around the selected en-route alternate aerodromes to establish a geographic boundary limitation for the planned route of flight. Examples of EDTO area of operations illustrations are provided in Section 3.5.1.3.

Note.— The EDTO area boundary for route-planning purposes is based on a constant, still-air diversion distance radius from overhead the aerodrome location and neither considers potential routing nor approach path and descent profile, wind and temperature variations which may be encountered during an actual diversion.

3.5.1.1.3 The area(s) of operation approved for EDTO should be specified in an operations specification. Flight dispatch limitations should specify the maximum diversion time from an EDTO en-route alternate aerodrome for which an air operator can conduct a particular EDTO operation. The planned maximum diversion time at the approved diversion speed should not be any greater than the value specified in the operations specification.

3.5.1.1.4 Refer to Section 3.2.2.9 (for twin-engine aeroplanes) or Section 3.2.3.7 (for aeroplanes with more than two engines) for guidelines on how to convert maximum diversion time into distance.

3.5.1.2 ***EDTO entry and exit points — EDTO sector***

3.5.1.2.1 The EDTO sector comprises the portion or portions of an EDTO route that extends beyond the threshold circles (i.e. the 60-minute circles in the example shown below) centred on each en-route alternate aerodrome. The beginning of the EDTO sector is the first point on the route that is beyond the EDTO threshold time/distance from an en-route alternate aerodrome and is also called the EDTO entry point (EEP). The end of the EDTO sector is the last point on the route that is beyond the EDTO threshold time/distance from an en-route alternate aerodrome, which is also called the EDTO exit point (EXP).

3.5.1.2.2 For example, the illustration in Figure 3.5-1 depicts an EDTO route from Mauritius (MRU) to Kuala Lumpur (KUL) based on a 60-minute EDTO threshold time. The EEP is reached once the route passes the 60-minute area circle centred around MRU. The EXP is the point on the route defined by the 60-minute area circle centred around Banda Aceh (BTJ).

3.5.1.2.3 As depicted in Figure 3.5-1, the aerodromes which define the EDTO entry and exit points on an EDTO route are not necessarily the departure and destination airports, but rather the last aerodrome within the applicable threshold time before the start of the EDTO sector and the first aerodrome after the EDTO sector where the remainder of the flight remains within the EDTO threshold time.

3.5.1.2.4 The EDTO entry and exit points on any given EDTO route are based on ISA still-air conditions and do not shift with prevailing winds. The EDTO sector which is defined by these points represents the portion of the route where the EDTO flight-planning considerations discussed in this chapter (fuel, alternate aerodromes, TLSs) are applied.

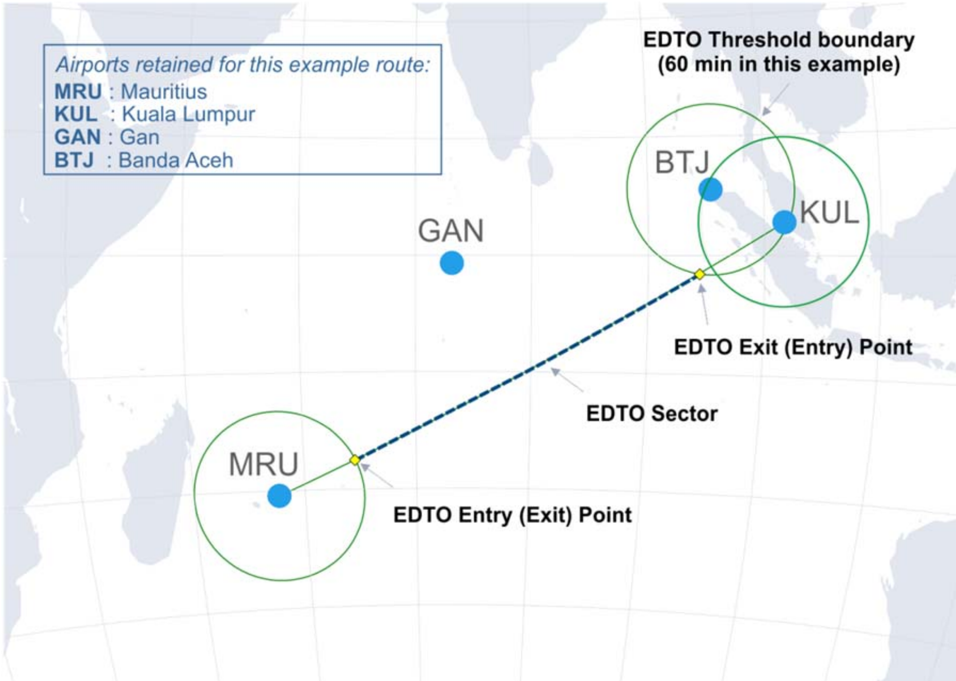

Figure 3.5-1. Example EDTO entry and exit points on EDTO route

3.5.1.2.5 An EDTO route may have multiple EDTO sectors if the route enters and exits EDTO airspace more than once or has a non-EDTO segment in the middle of the EDTO sector. Approved operators may plan such a flight based on multiple EDTO sectors (as illustrated in Figure 3.5-2a) or alternatively by treating the entire portion of the flight between the first EEP and the last EXP as a single EDTO sector (as illustrated in Figure 3.5-2b).

3.5.1.3 ***EDTO equal time points***

3.5.1.3.1 An equal time point (ETP) is the point of equal flying time between two EDTO en-route alternate aerodromes. The ETP can also be defined as, "the point at the farthest 'air mile' distance from a pair of EDTO en-route alternate aerodromes". The ETP(s) define(s) the point(s) of the route from where the EDTO flight planning requirements discussed in this chapter (fuel, alternate aerodromes, TLSs) apply.

3.5.1.3.2 Unlike the EDTO entry and exit points which are based on still-air conditions, ETPs consider actual weather conditions (wind, temperature) and so their position on the route may be offset from the geometric midpoint between any given pair of EDTO en-route alternate aerodromes. If the flight level, wind and temperature are the same in both diversion directions, then the ETP is the geographic midpoint on the route between the EDTO en-route alternate aerodromes. If the weather conditions are different, the ETP moves along the route towards the most adverse en-route weather conditions.

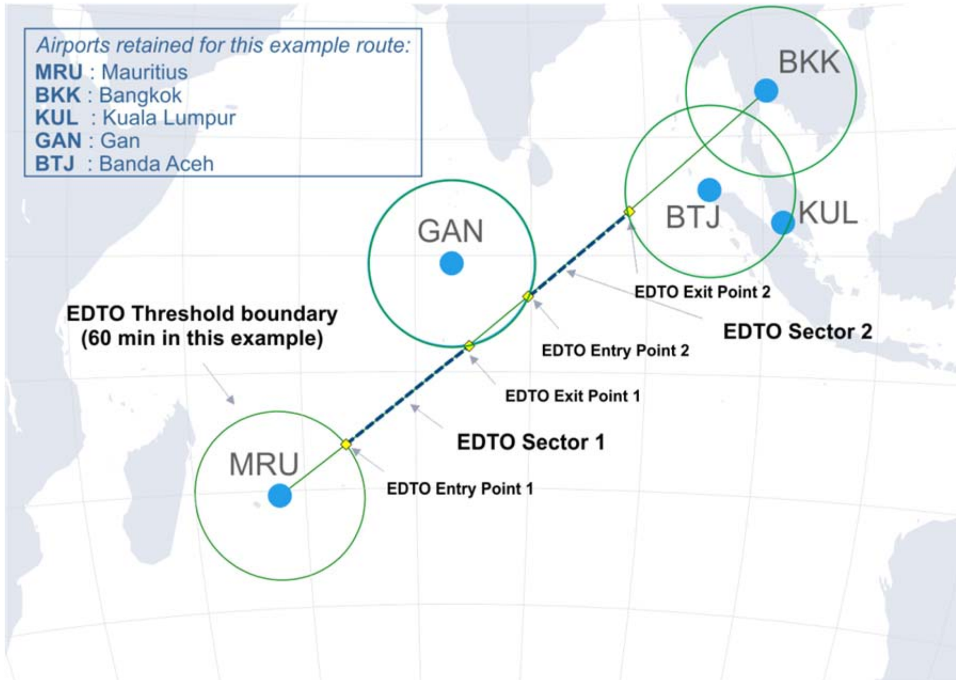

Figure 3.5-2a. Example of multiple EDTO sectors

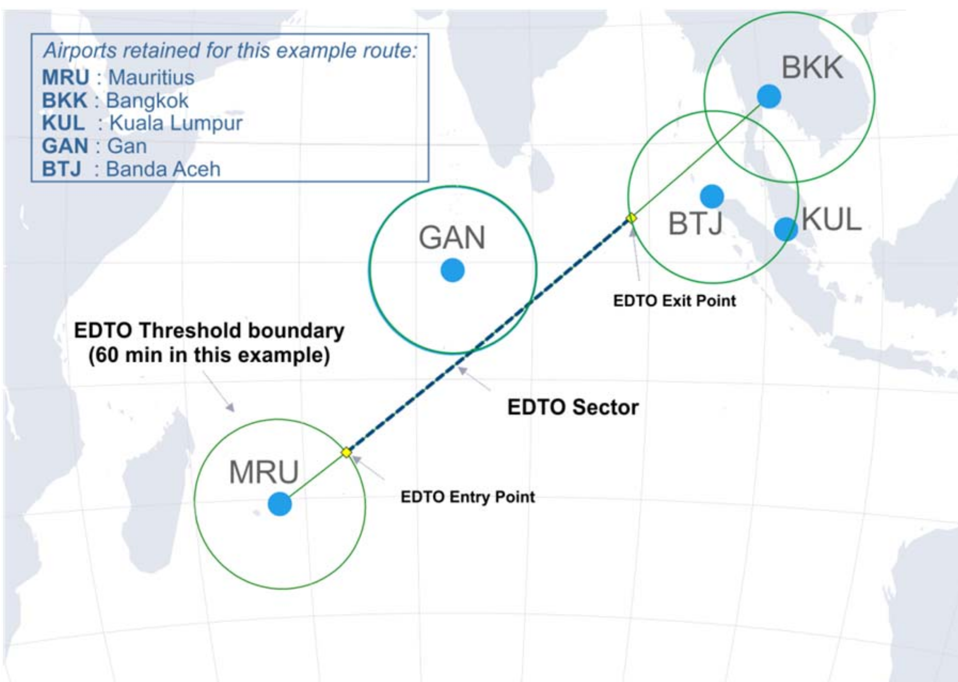

Figure 3.5-2b. Example of multiple EDTO sectors treated as a single sector

3.5.1.3.3 In the example shown in Figure 3.5-3a for a 120-minute EDTO flight from Mauritius to Kuala Lumpur, two EDTO ETPs are depicted in the EDTO sector. The first equal time point (ETP1) is defined by Mauritius and Gan Island as the first pair of designated EDTO en-route alternate aerodromes. The second equal time point (ETP2) is defined by the second pair of EDTO alternate aerodromes, Gan Island and Banda Aceh.

3.5.1.3.4 As shown in Figure 3.5-3b, a third equal time point (ETP3) is defined by the last pair of aerodromes, Banda Aceh (last EDTO alternate aerodrome) and Kuala Lumpur (destination aerodrome); however, it should be noted that ETP3 in this example is not within the EDTO sector, and thus EDTO flight planning considerations would not apply.

3.5.1.3.5 Figure 3.5-4 depicts the same route based on a 180-minute maximum diversion time with KUL as the last designated EDTO alternate aerodrome.

3.5.1.3.6 An EDTO route will typically have at least one ETP and may have several depending on the length of the EDTO sector, the selected EDTO en-route alternate aerodromes, and the applicable EDTO maximum diversion time.

3.5.1.3.7 The operator may elect to designate a single EDTO en-route alternate aerodrome to establish the EDTO area of operation, in which case there will be no ETP. See Figure 3.5-5. In such a case, diversion fuel and TLS protections should be assessed for any potential diversion track between the EDTO entry and exit points.

3.5.1.4 *Equal time point (ETP) calculations*

3.5.1.4.1 The flight condition, flight level and associated forecast weather used to determine the position of EDTO ETPs within the EDTO sector may vary depending on the particular EDTO flight planning requirement being addressed, the type of aeroplane and the specific requirements established by the State of the Operator.

3.5.1.4.2 ETPs need to be established for:

a) computing the EDTO diversion fuel (Sections 3.5.3.2 and 3.5.3.3);

b) checking the maximum diversion time versus the applicable TLS values (Section 3.5.4); and

c) in-flight diversion decision-making (Section 3.6.2).

3.5.1.4.3 ETPs established for the purpose of EDTO diversion fuel planning are typically determined based on a decompression flight level of 10 000 ft (3 000 m). A higher decompression flight level may be assumed if supported by the aeroplane's supplemental oxygen supply and/or required to maintain minimum en-route altitudes along the diversion flight path. A second ETP based on engine inoperative altitude may also be determined if diversion fuel protection is required for an engine–failure-only condition.

Note 1.— Operators may elect to standardize on a single ETP calculation (either decompression or engine failure) to simplify their flight planning process and flight plan presentation.

Note 2.— While Annex 6 EDTO fuel protection requirements for a pressurized engine failure condition are applicable to two-engine aeroplanes only, some States have extended this requirement to all aeroplanes engaged in EDTO operations.

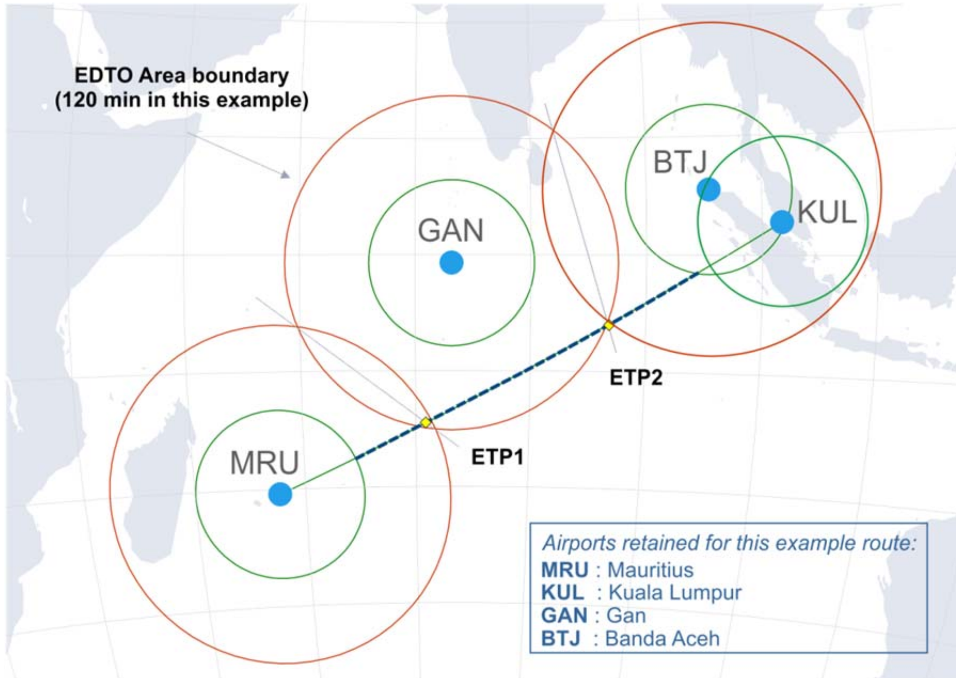

Figure 3.5-3a. Example EDTO equal time points (ETPs) (120 minutes)

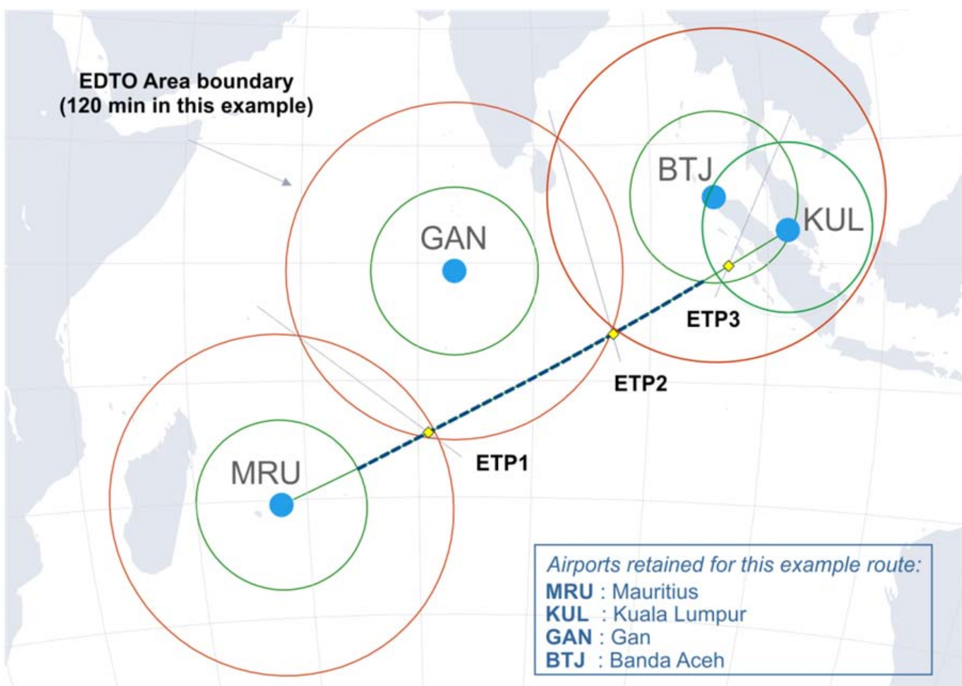

Figure 3.5-3b. Example equal time point out of EDTO sector (ETP3)

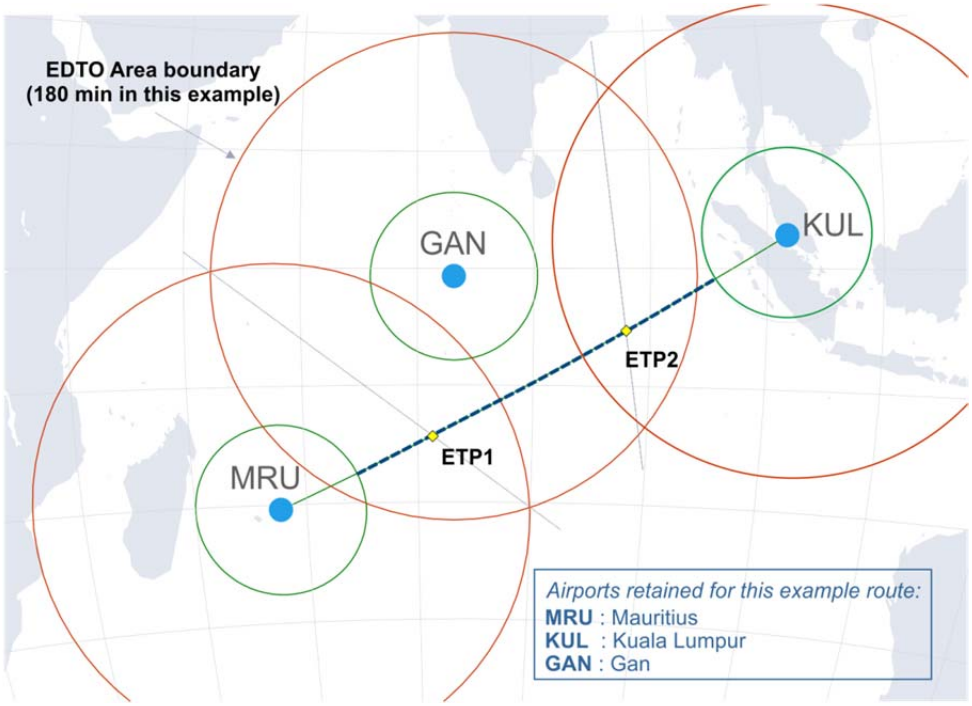

Figure 3.5-4.   Example EDTO equal time points (ETPs) (180 minutes)

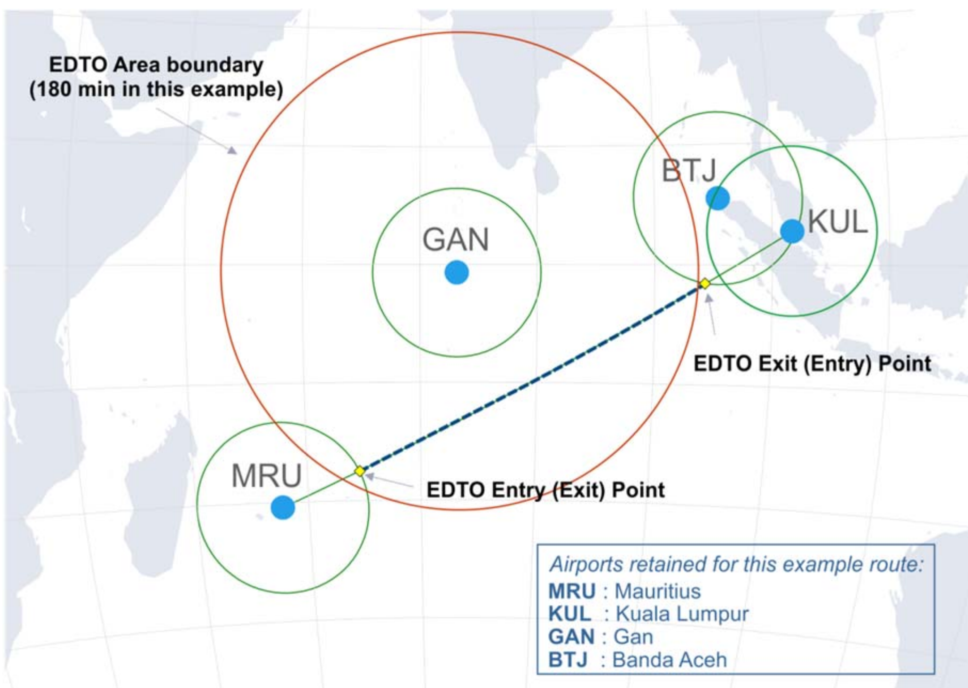

Figure 3.5-5.   Single EDTO alternate example with no EDTO equal time points (ETPs) (180 minutes)

3.5.1.4.4 ETP determination for the purpose of EDTO TLS planning may introduce yet another ETP calculation based on all-engine cruise speed and flight level, as this is the relevant flight condition used to evaluate cargo fire suppression diversion time protection for EDTO operations beyond 180 minutes under most State regulations. For aeroplanes where another EDTO significant system time other than cargo fire suppression has been established, the ETP basis used to evaluate diversion time protection for the other system is typically an engine failure condition with forecast weather conditions considered if the EDTO operation is beyond 180 minutes.

3.5.1.4.5 For EDTO operations up to and including 180 minutes, EDTO TLS requirements are typically directly related to the still-air EDTO maximum diversion time with a minimum additional margin of 15 minutes. For these operations, forecast weather conditions are not considered for EDTO TLS planning and therefore it is not necessary to determine TLS ETPs for EDTO flight planning purposes.

Note. — EDTO operations up to and including 180 minutes may also encompass 15 per cent extensions to this authority (e.g. up to 207 minutes).

3.5.1.4.6 For in-flight progress monitoring and diversion decision-making, EDTO ETPs are typically considered to be the points along the route where the preferred or primary en-route diversion aerodrome switches to the next EDTO alternate listed on the operational flight plan. At the ETP itself, the diversion time to each of the two en-route alternate aerodromes which define the ETP is the same; however, as the flight passes the ETP it will get progressively closer to one aerodrome which becomes the new primary diversion aerodrome and progressively further away from the other aerodrome which was primary before passing the ETP. This same transition will occur at each ETP in the EDTO sector for cases where multiple ETPs are listed and a single listed EDTO alternate will be primary between any two sequential ETPs. Decompression ETPs are typically used as the basis for en-route progress monitoring relative to EDTO diversion aerodromes; however, operators may elect to also evaluate AEO and/or OEI ETPs for diversion decision-making, depending on the nature of the in-flight emergency and with due consideration for the increased complexity of managing multiple decision points between diversion aerodromes.

Note. — Operators may choose to include the EDTO ETPs in the operational flight plan navigation log and/or as position fixes on the flight management system navigation displays to aid the flight crew with flight progress monitoring relative to the EDTO sector.

3.5.1.4.7 In the event of a diversion on an EDTO flight, the flight crew is not obligated to divert to the primary EDTO alternate aerodrome listed on the flight plan and may chose a different aerodrome as the nearest suitable landing site if this is deemed to be a safer course of action based on prevailing operational conditions.

3.5.1.4.8 Other considerations related to in-flight decision making are discussed in Section 3.6.2.

3.5.2 Alternate aerodromes for EDTO

3.5.2.1 *General*

3.5.2.1.1 Alternate aerodromes, for the purposes of EDTO planning, are those aerodromes which an operator has been authorized to designate for en-route diversion planning within an approved EDTO area of operation. The operational assessment of these aerodromes typically involves two separate considerations, namely:

a) the basic adequacy of the aerodrome to support a safe approach and landing independent of operational variances; and

b) the forecast conditions at the designated aerodromes to support a safe approach and landing at the expected times of use during a particular EDTO flight.

3.5.2.1.2 These separate and complementary considerations may be defined by specific terms and criteria in State regulations such as “adequate aerodrome” and “EDTO alternate aerodrome”.

3.5.2.1.3 An “adequate aerodrome” is an aerodrome which has been assessed to meet fundamental considerations other than weather, such as required runway length and an available approach procedure. These aerodromes are generally listed in an approved operator’s manual.

3.5.2.1.4 An “EDTO alternate aerodrome” is an adequate aerodrome which has been designated for a particular EDTO flight based on a dispatch assessment of the operational criteria outlined in the following section. The designated aerodromes should be listed in the operational flight plan.

3.5.2.1.5 These fundamental concepts are used in most State regulations and operator programmes; however, specific terminology and criteria may vary among Member States.

3.5.2.2 ***Landing performance considerations***

3.5.2.2.1 The runway length assessment for the adequate aerodromes selected to support an EDTO operation should typically be based on the AFM landing performance information provided by the manufacturer and defined in accordance with item e) *Landing* of Section 2.2.7 (Scheduling of performance) of Annex 8 — *Airworthiness of Aircraft,* Part IIIB. The required runway length at the expected landing mass may be based on the dry runway performance considerations outlined in Attachment B, Section 7.1 of Annex 6, Part I. Another method to determine the landing distance that can realistically be achieved in line operations (e.g. considering actual aeroplane stopping performance and runway surface condition) may be used if accepted by the State of the Operator.

3.5.2.2.2 Overweight landing procedures may need to be considered for EDTO diversion planning. For aeroplanes equipped with fuel jettison systems, expected landing mass may be reduced to allow for fuel jettisoning provided the operator can demonstrate that flight crews are properly trained and that diversion fuel requirements (Section 3.5.3) are not compromised.

3.5.2.2.3 The EDTO alternate aerodromes selected for a particular EDTO flight should be further evaluated to ensure sufficient runway length for the conditions at the expected time of arrival as part of the dispatch planning assessment. This assessment should take into account probable wind speed and direction, as well as expected runway surface condition.

3.5.2.2.4 For aerodromes with limiting local terrain, an evaluation of go-around climb gradient capability in the event of a missed approach following an OEI diversion may also need to be considered in the landing performance assessment.

3.5.2.3 ***Validity period/time window***

3.5.2.3.1 The validity period is the time window during which a designated EDTO alternate aerodrome should be assessed for EDTO dispatch purposes to have the necessary conditions to allow a safe approach and landing in the event of an en-route EDTO diversion. The applicable time window should consider the earliest to latest expected arrival times for each EDTO alternate aerodrome based on the planned departure time. The validity period for a given EDTO alternate aerodrome is typically determined based on a diversion from the first and last EDTO ETPs for this alternate.

3.5.2.3.2 Figure 3.5-6a illustrates this concept for the MRU-KUL route using GAN as an example. A “forward” diversion to GAN from ETP1 (MRU/GAN) would constitute the earliest estimated time of arrival (ETA) since ETP1 is the first point on the route where GAN becomes the primary planned EDTO alternate. Similarly, a “backward” diversion to GAN from ETP2 would represent the latest ETA since ETP2 is the last point along the route where GAN is the primary planned EDTO alternate.

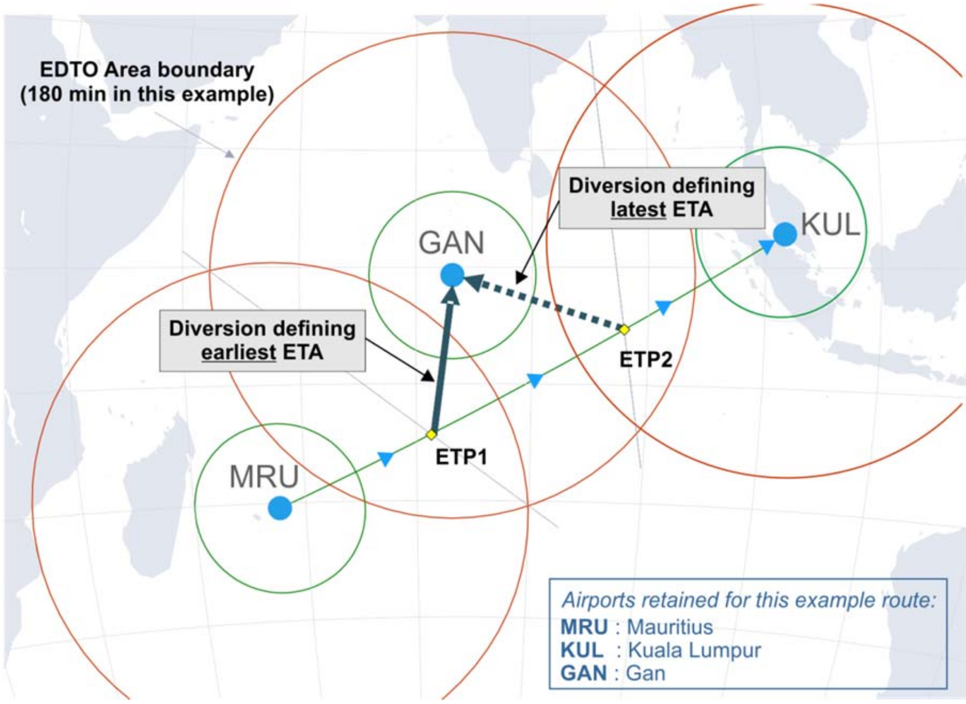

Figure 3.5-6a. EDTO alternate validity period

3.5.2.3.3 The earliest to latest arrival times may consider different diversion flight profiles, for example, high speed vs low speed cruise, or may be standardized on a specific EDTO non-normal flight profile, such as an engine failure or decompression, depending on the State of the Operator's requirements and operational flight planning system implementation. Further, the required validity period may be expanded in some cases to include an additional margin such as one hour after the latest arrival time if dictated by the State of the Operator's regulations.

3.5.2.3.4 For cases where the EDTO alternate aerodrome is located before the EDTO EEP (e.g. first EDTO alternate) or after the EDTO EXP (e.g. last EDTO alternate), the concept of earliest to latest arrival time is less obvious because there is not both a "forward" and a "backward" diversion track within the EDTO sector as was illustrated in Figure 3.5-6a. For these cases, the validity period as determined by the operational flight planning system should consider the potential en-route diversion exposure during the EDTO portion of the flight to include the EEP if the EDTO alternate aerodrome is located before the start of the EDTO sector and the EXP for the case of the last EDTO alternate aerodrome located after the EDTO sector.

3.5.2.3.5 This concept is illustrated in Figure 3.5-6b using MRU and KUL as examples. The validity period exposure for MRU as the first EDTO alternate aerodrome positioned before the start of the EDTO sector would be a backward diversion from the EEP and a backward diversion from ETP1 based on the assumed diversion flight profile(s) implemented in the operational flight planning system. The route of flight from the EEP to ETP1 is also the portion of the EDTO sector where MRU is the primary planned EDTO alternate aerodrome. Similarly, the validity period for KUL would consider a forward diversion from ETP2 and from the EXP to cover the portion of the EDTO sector where KUL is the primary planned diversion alternate aerodrome.

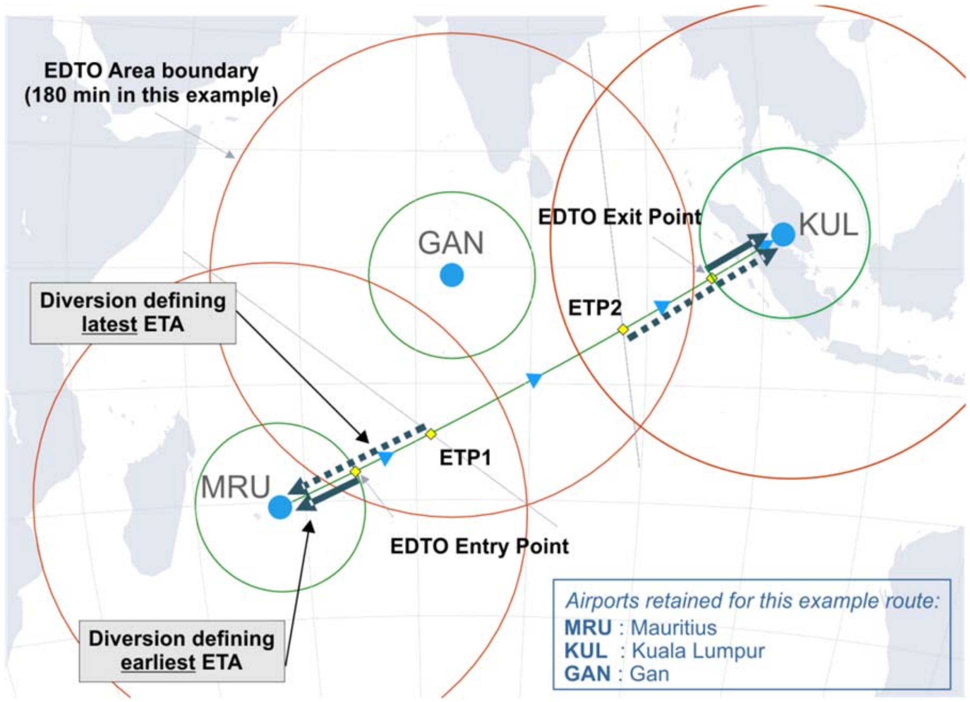

Figure 3.5-6b. Validity period of EDTO alternates located before or after the EDTO sector

3.5.2.3.6 Another unique case for the purpose of validity period determination is when a single EDTO alternate aerodrome is used to cover the entire EDTO sector as was previously discussed in Section 3.5.1.3 (Figure 3.5-5). For this case there are no EDTO ETPs, and the single EDTO alternate is therefore the primary planned diversion aerodrome for the entire EDTO sector. Consequently, the validity period should consider a forward diversion from the EEP to establish the earliest expected arrival time and a backward diversion from the EXP to establish the latest expected arrival time. This concept is illustrated in Figure 3.5-6c.

3.5.2.3.7 The EDTO alternate aerodrome validity period assessment should consider forecast weather conditions including visibility and ceiling minima based on the latest available information with appropriate dispatch planning margins as discussed in the next section. Hours of operation, NOTAMs, forecast winds and other operational factors may also be included in the assessment to ensure that a safe approach and landing can be accomplished within the applicable time window.

3.5.2.4 *EDTO alternate aerodrome weather minima*

3.5.2.4.1 EDTO alternate aerodrome weather minima, for the purpose of dispatch planning, should be defined in State regulations to include specific criteria for ceiling and visibility to ensure that forecast weather conditions will allow a safe approach and landing in the event of an en-route EDTO diversion. These weather minima should be assessed based on the latest available forecast information for the required validity period (Section 3.5.2.3) for each designated EDTO alternate aerodrome.

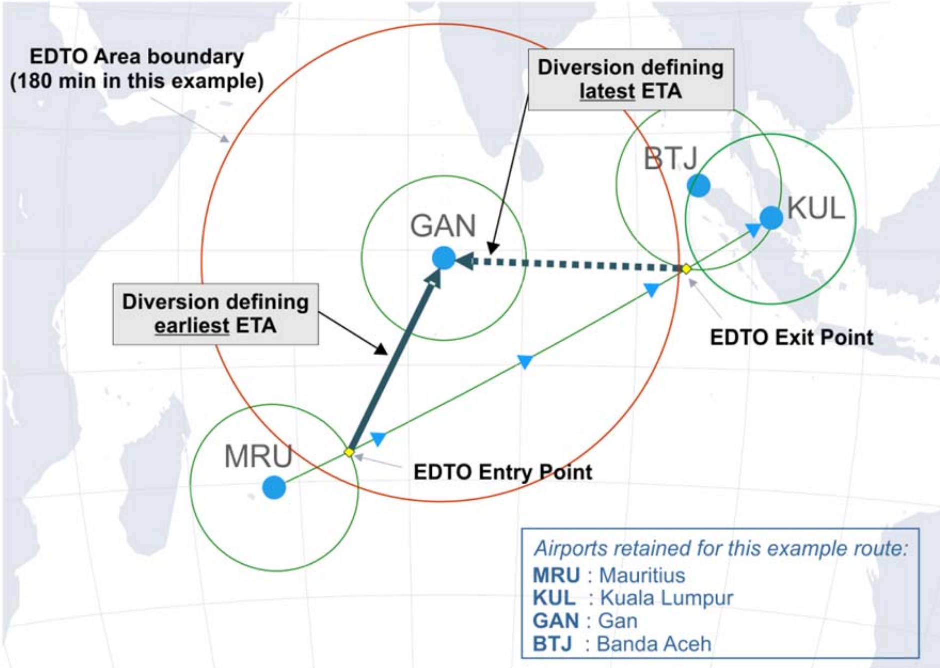

Figure 3.5-6c. Validity period of the single EDTO alternate

3.5.2.4.2 The EDTO dispatch planning minima requirements are typically expressed as additives to the published operating minima for a particular approach or may also be expressed as fixed minima values. In either case, the intent of the requirements is that the aerodrome minima assessed for dispatch planning purposes are more conservative than the actual published operating minima required to conduct an approach and landing. This is to allow for the potential of deteriorating weather conditions after the EDTO flight has commenced, as illustrated in the following example. EDTO alternate aerodrome status monitoring and weather minima considerations once the EDTO flight is en-route are addressed separately in Section 3.6.2.2.

3.5.2.4.3 Table 3-2 provides an example of how additional weather minima margins may be defined for EDTO flight preparation purposes.

Table 3-2. Example EDTO dispatch planning minima

Approach facility	*Ceiling*	*Visibility*
Precision approach	Authorized DH/DA plus an increment of 60 m (200 ft)	Authorized visibility plus an increment of 800 m
Non-precision approach or circling approach	Authorized MDH/MDA plus an increment of 120 m (400 ft)	Authorized visibility plus an increment of 1 500 m

3.5.2.4.4 As a practical example of applying the dispatch planning minima depicted in Table 3-2, consider Gan Island, Maldives (GAN) which was used to illustrate the EDTO sector and EDTO ETP concepts discussed in Sections 3.5.1.2 and 3.5.1.3.

3.5.2.4.5 GAN has a single landing surface as depicted in Figure 3.5-7 with opposing runway ends, RWY 10 and RWY 28. Each runway has several published non-precision approach procedures which provide for VOR DME, VOR, NDB and GPS approaches. Operators will typically plan for the most favourable authorized approach procedure and runway end when applying the EDTO planning minima, which in this case would be the GPS approach procedure from the standpoint of required ceiling or minimum descent altitude (MDA) as depicted in Figure 3.5-8 for RWY 28.

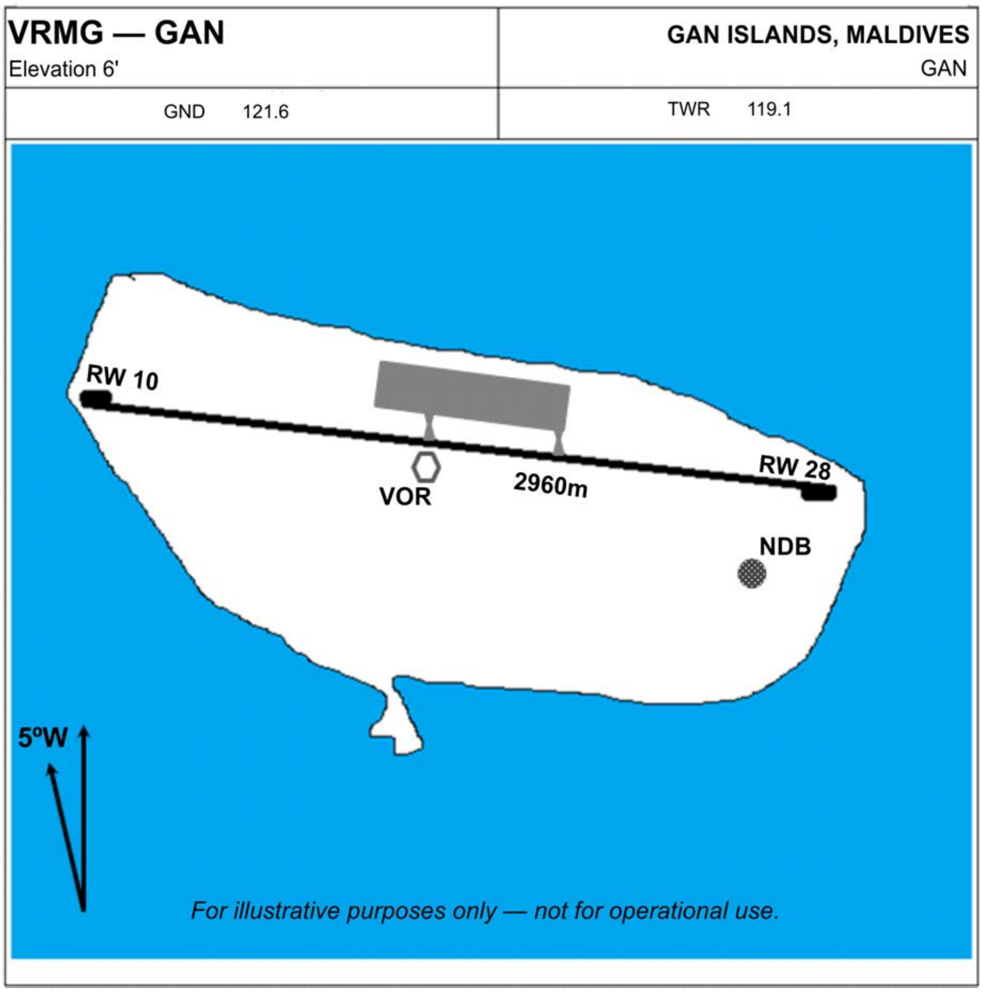

Figure 3.5-7. Gan Island Airport (GAN) example diagram

RWY 28	MDA	RVR	Circling
A	**360 ft**	1 200 m	**400 ft** (1 600 m)
B			**500 ft** (1 600 m)
C			**600 ft** (2 400 m)
D	**360 ft**	2 000 m	**700 ft** (3 600 m)

Figure 3.5-8. GAN RWY 28 GPS approach minima

3.5.2.4.6 For an Approach Category D aeroplane planning for a straight-in approach to land, the required operating minima based on Figure 3.5-8 would be a ceiling (MDA) of 360 ft and a visibility of 2 000 m. Applying the additional margins depicted in Table 3-2 would yield required EDTO dispatch planning minima of 760 ft (360 ft + 400 ft) ceiling and 3 500 m (2 000 m + 1 500 m) visibility.

3.5.2.4.7 These more conservative weather minima would apply for dispatch planning purposes only and would need to be verified based on the latest available weather forecasts for the required validity period/time window discussed in Section 3.5.2.3.

Note 1.— Circle-to-land approach procedures are not normally used for EDTO planning; however, if used, the same dispatch margins would apply to the published circling approach minima.

Note 2.— Approved required navigation performance (RNP) approach procedures may be utilized for EDTO planning, based on the requirements set forth by the State of the Operator as per Section 7.2. (Navigation equipment),7.2.2 of Annex 6, Part I. Refer also to the Performance-based Navigation (PBN) Manual *(Doc 9613) and the* Performance-Based Navigation (PBN) Operational Approval Manual (*Doc 9997) for further guidance on PBN operations, which remains valid for EDTO.*

3.5.2.4.8 Consideration for conditional forecast elements may also be defined, for example, a PROB 40 or TEMPO condition below the lowest applicable operating minima is normally taken into account. Provisions for low landing minima (e.g. Category 2/3) may also be included in State regulations, contingent upon operator approval and aeroplane capability to conduct such operations.

Note.— The terms "Operating minima" or "landing minima" refer to the minima on the applicable approach chart, and not to the EDTO planning minima described in 3.5.2.4.2.

3.5.2.4.9 When dispatching under the provisions of the MEL, those MEL limitations affecting instrument approach minima should be considered in assessing the EDTO alternate aerodrome minima as should any NOTAMs affecting the published approach procedure.

3.5.2.4.10 The EDTO planning minima apply for dispatch only. Once the flight has commenced, the normal published operating minima required to conduct a safe approach and landing are applicable (see 3.6.2.2).

3.5.2.5 ***Rescue and firefighting services (RFFS)***

3.5.2.5.1 In accordance with Section 4.1.5 of Annex 6, Part I, the RFFS protection of the EDTO alternate aerodromes that are deemed acceptable by the operator shall be contained in the operations manual.

3.5.2.5.2 As per the guidance contained in related Attachment I of Annex 6, Part I, an acceptable RFFS protection for en-route EDTO alternate aerodromes may be either:

a) aerodrome RFFS Category 4 for aeroplanes with maximum certificated take-off mass of over 27 000 kg, or aerodrome RFFS Category 1 for all other aeroplanes, if the operator can provide 30 minutes of notification; or

b) if the operator cannot provide the above 30 minutes of notification, an acceptable RFFS protection may be two categories below the aeroplane RFFS category.

3.5.2.5.3 In the case where the departure and/or the destination aerodromes and/or the departure and/or the destination alternate aerodromes are also EDTO alternate aerodromes, the acceptable RFFS protection would need to comply with the most restrictive of the applicable requirements of Attachment I to Annex 6, Part I.

Note. — Further reductions of the RFFS capability for all-cargo operations might be acceptable. Refer to Attachment I to Annex 6, Part I, for related applicable guidance.

3.5.3 EDTO fuel requirements

3.5.3.1 ***General***

3.5.3.1.1 In addition to the normal contingency and reserve fuel requirements associated with non-EDTO flight operations, fuel planning for an EDTO flight must also consider the potential for an en-route diversion to a designated EDTO alternate aerodrome. This additional fuel planning protection is commonly referred to as the EDTO critical fuel scenario and is an important aspect of the EDTO flight preparation process.

3.5.3.1.2 The EDTO critical fuel requirement considers the potential for the following three failure scenarios from the most fuel-critical EDTO ETP or "critical point" (CP) between designated EDTO alternate aerodromes as illustrated in Figure 3.5-9:

a) all-engine depressurization;

b) one-engine-inoperative depressurization; and

c) engine failure only (two-engine aeroplanes only).

3.5.3.1.3 The fuel required to satisfy the most limiting of these diversion scenarios will determine if additional EDTO critical fuel reserves are required for an EDTO flight. If the EDTO critical diversion fuel is less than the normal planned mission and reserve fuel remaining at the CP, there is no additional EDTO fuel uplift required. If, however, the normal planned fuel on board at the CP does not satisfy the critical fuel requirement, then additional EDTO reserve fuel uplift is required.

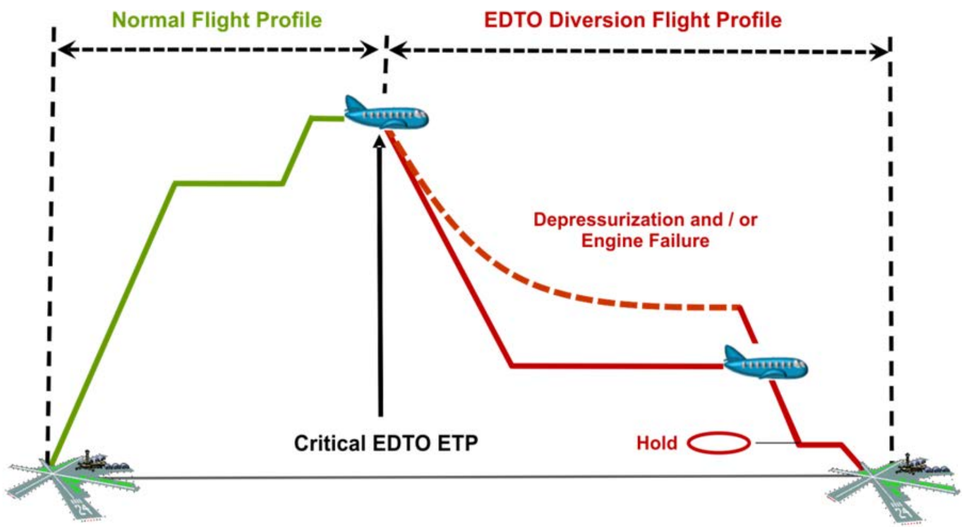

Figure 3.5-9. EDTO critical fuel scenarios

3.5.3.1.4 Figure 3.5-10a illustrates the case where no additional EDTO critical fuel uplift is required. The normal fuel calculation build-up on the left side of the figure depicts the total fuel uplift for an example flight including taxi, trip, contingency and normal reserve fuel. The right side of the figure depicts the normal trip fuel burn up to the CP and then the fuel required to satisfy the critical fuel diversion scenario. Since the total fuel required to satisfy EDTO fuel requirements on the right side of the figure is less than the normal fuel uplift on the left side of the figure, there is no need to adjust the normal planned fuel load for the purpose of EDTO diversion fuel protection.

3.5.3.1.5 Alternatively, Figure 3.5-10b illustrates a case where additional fuel uplift is required to satisfy EDTO fuel planning requirements. In this case, the EDTO fuel planning build-up shown on the right of the figure is greater than the normal fuel calculation shown on the left. As such, the normal planned fuel load must be adjusted by the additional fuel which represents the difference between the EDTO fuel calculation and the original normal fuel calculation.

3.5.3.1.6 Further details concerning the EDTO critical fuel calculation are provided in Section 3.5.3.2. Example operational applications are addressed in Section 3.5.3.3.

3.5.3.2 ***EDTO critical fuel reserve calculation***

3.5.3.2.1 The EDTO critical fuel calculation can be best described in further detail by separating the diversion profiles into individual flight segments as follows:

a) descent from normal cruise altitude;
b) cruise to EDTO alternate aerodrome;
c) descend and hold over EDTO alternate aerodrome;
d) approach and land at EDTO alternate aerodrome; and
e) additional fuel allowances.

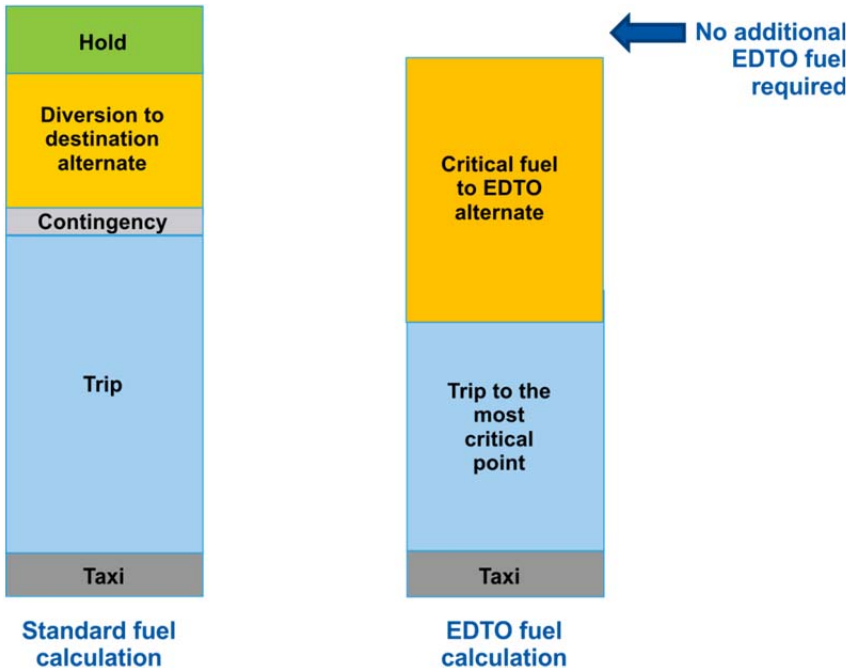

Figure 3.5-10a. No additional EDTO fuel required

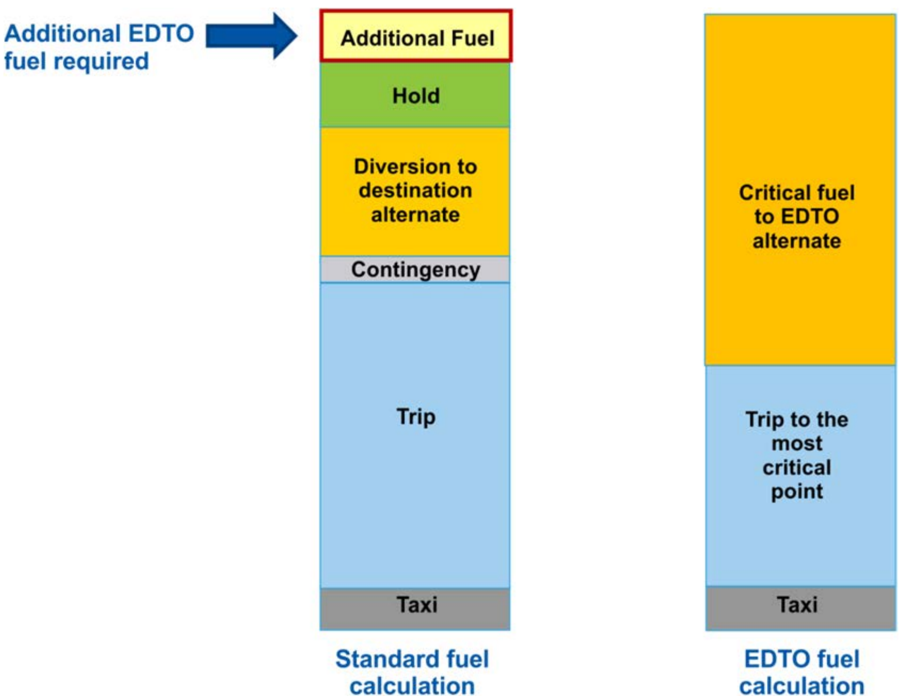

Figure 3.5-10b. Additional EDTO fuel required

3.5.3.2.2 While State regulations and flight planning system implementations can vary on the specifics of how these fuel requirements are determined, some common considerations should include the following:

— **Descent from normal cruise altitude**

i) For the AEO and OEI depressurization scenarios, an emergency descent to depressurization altitude per the particular aeroplane's emergency descent procedures. The depressurization altitude is typically considered to be 3 000 m (10 000 ft); however, a higher altitude may be planned for if the aeroplane is equipped with sufficient supply for the planned diversion time.

Note. — Although oxygen requirements are generally considered to be separate from EDTO requirements, oxygen requirements still need to be complied with for both EDTO and non-EDTO operations. This includes the assumed depressurization diversion flight level used to calculate the EDTO critical fuel scenario which may be constrained by available oxygen supply. Oxygen requirements are addressed in Section 4.3.9 of Annex 6, Part I. Additional requirements may be imposed by some State regulations.

ii) For the engine failure only scenario, if applicable, a normal idle descent to thrust limited altitude or a thrust limited driftdown profile with MCT on the operating engine. The assumed driftdown speed is typically the same Mach/IAS speed schedule that is used to determine the maximum EDTO diversion distance (Section 3.2.1). It may therefore be a different speed than the one selected to define the EDTO threshold.

Note. — While an engine failure only critical fuel scenario is defined in Attachment C to Annex 6, Part I, for two-engine aeroplanes, this condition is rarely limiting. This is because the depressurization scenarios are typically based on a lower diversion flight level and thus carry a higher diversion fuel requirement. Consequently, some operators will not include the engine failure only scenario in their EDTO dispatch fuel calculations if determined to be a non-limiting condition.

— **Cruise to EDTO alternate aerodrome**

i) For two-engine aeroplanes, the cruise speed used to calculate the engine failure critical fuel scenarios (engine failure combined with decompression and engine failure alone) should be the same as the approved OEI speed used to determine the EDTO maximum diversion distance (Section 3.2.1). The cruise speed used for the all-engine decompression scenario calculation may be a different speed and is typically assumed to be all-engine long-range cruise (LRC) speed. There is no requirement to use the approved OEI speed for the all-engine critical fuel calculation.

Note. — The OEI speed used to calculate EDTO maximum diversion distance and engine inoperative critical fuel requirements for two-engine aeroplanes may vary for different geographic regions depending on route requirements, EDTO maximum diversion time, and availability of en-route diversion aerodromes. Further, the OEI speed used to establish the 60-minute and threshold distances for a non-EDTO operation may be different than the speed selected for an EDTO operation. EDTO fuel planning requirements are not applicable to an operation that remains within the established EDTO threshold distance.

ii) For aeroplanes with more than two engines, there is no particular relationship between the speed used to establish maximum diversion distance and the assumed cruise speeds for the EDTO critical fuel calculation. Specifically, the speeds used to calculate the AEO and OEI decompression scenarios may be different speeds than the approved AEO speed used to determine the EDTO maximum diversion distance (Section 3.2.2). The engine failure only scenario is not applicable to aeroplanes with more than two engines.

iii) The relationship between the speed basis for threshold distance, EDTO maximum diversion distance and the EDTO critical fuel calculations is summarized in Table 3-3.

Table 3-3. EDTO critical fuel scenario cruise speed modes

	60 Min/EDTO Threshold Distance	EDTO max diversion distance	Critical Fuel – All engine depressurization	Critical Fuel – Engine inoperative depressurization	Critical Fuel – Engine failure only
Two engine aeroplanes	**Any selected OEI speed**	**Approved OEI speed**	**Any selected AEO speed**	**Approved OEI speed**	**Approved OEI speed**
Aeroplanes with more than two engines	**Any selected AEO speed**	**Approved AEO speed**	**Any selected AEO speed**	**Any selected OEI speed**	Not applicable

— **Descend and hold over EDTO alternate aerodrome**

The critical fuel calculation should allow for a normal descent to 450 m (1 500 ft) above the EDTO alternate aerodrome followed by 15 minutes of holding. The descent is initiated from either depressurization or engine inoperative altitude depending on the particular scenario.

— **Approach and land at EDTO alternate aerodrome**

Fuel allowance for a standard instrument approach and landing should be included. A missed approach fuel allowance may also be specified in some State regulations; however, this additional fuel is not included in the EDTO Standards.

— **Additional fuel allowances**

Annex 6, Part I, Attachment C, describes certain additional fuel allowances which should be included in the EDTO critical fuel calculation. These additional fuel allowances and the typical application in State regulations may be summarized as follows:

- Fuel to account for icing:

  This allowance is typically based on the higher of two fuel requirements, as determined from operational fuel planning data provided by the aeroplane manufacturer and the operator's assessment of potential diversion icing exposure for the EDTO flight:

  1. fuel to account for engine anti-ice, and if applicable, wing anti-ice, for the entire time during which icing is forecast; or

  2. fuel for the effect of potential ice accumulation on unheated surfaces (airframe icing) for 10 per cent of the time during which icing is forecast including the fuel used for engine and wing anti-ice during this period.

- Fuel to account for errors in wind forecasting:

  This fuel allowance is typically determined by applying a 5 per cent factor to the forecast wind magnitude (increase for headwind, decrease for tailwind) if the operator is using actual forecast winds based on a wind forecast model accepted by the authority. If the operator is not using actual forecast winds based on a wind model accepted by the authority, an additional 5 per cent fuel allowance should be applied to the total critical fuel requirement to allow for errors in wind data.

- Fuel to account for deterioration in cruise fuel-burn performance:

  This additional fuel allowance is typically based on operational analysis of actual cruise fuel mileage performance using tools provided by the aeroplane manufacturer or other sources. The analysis is normally performed for each aeroplane conducting EDTO operations, as deterioration factors can vary within an operator's fleet. If the operator is not performing cruise fuel mileage analysis for its EDTO operation, an additional 5 per cent fuel factor should be added to the total critical fuel requirement to account for potential deterioration in cruise fuel-burn performance.

  Note. — The fuel-burn performance of a particular aeroplane may be better than the performance level used for operational flight planning. For cases where the actual aeroplane performance has been determined to be better than the planning database level, the fuel-burn deterioration factor should be zero.

- Fuel to account for auxiliary power unit (APU) use (if required):

  If the APU is a required power source for the EDTO critical fuel diversion scenarios, the additional fuel consumption required to operate the APU should be included in the relevant diversion scenarios. For most aeroplanes, APU fuel is included in the engine failure critical fuel scenarios but is typically not included in the all-engine depressurization scenario unless required by aeroplane specific operating procedures.

- Fuel to account for any relevant configuration deviation list (CDL) and/or MEL items.

3.5.3.3 *EDTO critical fuel operational application*

3.5.3.3.1 The operational application of the EDTO critical fuel requirement consists of the requisite flight preparation calculations and the presentation of these results on the operational flight plan. The operator's flight planning system should have the capability to determine the critical fuel required (CFR) as described above and the normal planned fuel load at each EDTO ETP to determine if a fuel load adjustment is needed for a particular EDTO flight.

3.5.3.3.2 Flight planning system implementations and flight plan formats for EDTO critical fuel can vary, and it is important to recognize that operators engaged in EDTO operations may use different methods to meet the requirements. Figure 3.5-11a provides an example of a typical flight plan presentation of EDTO critical fuel information for the MRU - KUL route. In this example, no additional critical fuel uplift is required because the normal fuel on board (FOB) is greater than the CFR at each of the two EDTO ETPs. This can be seen by comparing the FOB and CFR values and also because there is excess fuel (EXC) at each ETP. Note that in this example, ETP2 is the CP since the EXC is the lowest, even though there is no critical fuel adjustment required.

	DIST	W/C	CFR	FOB	EXC	TIME TO ETP / ALT
ETP1 FIMP/VRMG	0873/0845	P012/P000	016493	031564	015071	01.57/02.26
S14456 E071438						
ETP2 VRMG/WMKK	0964/0994	P003/P013	018164	019569	001405	04.23/02.45
S06438 E088048						

Figure 3.5-11a. Critical fuel flight plan example (no additional uplift)

3.5.3.3.3 Figure 3.5-11b depicts a case for the same EDTO route example where a critical fuel adjustment is applied. Note that in this case, the CFR and FOB values are equal at ETP2 and the EXC is zero which indicates that the required fuel load was adjusted to meet the critical fuel requirement. The additional fuel adjustment, when required, will often also be indicated as “EDTO ADD” or “EDTO EXTRA” on the flight plan fuel build-up summary (Figure 3.5-11c).

	DIST	W/C	CFR	FOB	EXC	TIME TO ETP / ALT
ETP1 FIMP/VRMG	0873/0845	P012/P000	016493	030159	013666	01.57/02.26
S14456 E071438						
ETP2 VRMG/WMKK	0964/0994	P003/P013	018164	018164	000000	04.23/02.45
S06438 E088048						

Figure 3.5-11b. Critical fuel flight plan example (with additional uplift)

	FUEL	TIME					
				OWE	85061	PYLD	26803
DEST WMKK	34963	6+58	. . . .	EZFW	111864	MZFW	120300
RESV	3406	0+47	. . . .	ETOW	154500	MTOW	154500
DEST-MNVR	0	0+ 0	. . . .	ELDW	119537	MLDW	127800
ALTERNATE	0	00+00	. . .				
HOLD-ALT	2203	00+30	. . . .				
EDTO ADD	2064	00+28					
REQD	042636	08+43					
EXTRA	000000	00+00					
TAXI	100						
TOTAL	042736	08+43					

Figure 3.5-11c. EDTO critical fuel flight plan adjustment

3.5.4 Time-limited system (TLS) considerations

3.5.4.1 ***General***

3.5.4.1.1 There are two kinds of TLS:

a) the systems limited by their capacity, e.g. the cargo fire extinguishers. Per design they cease to function once exhausted. The sizing of those systems may therefore have an impact on the aeroplane's maximum diversion time capability; and

b) the systems for which time capability is determined by their endurance or reliability. Systems falling into this category are normally designed to function over a duration which largely exceeds the duration of one flight. Therefore, the sizing of those systems usually has no impact on the aeroplane's maximum diversion time capability. For this reason, it is usually the maximum diversion time assumptions from the safety analyses that will define the related time limitation.

3.5.4.1.2 The time limitation of these systems may have to be considered in the design and the operation of an aeroplane for EDTO to ensure that EDTO operations are conducted within diversion times compatible with the capabilities of the relevant TLSs (see 2.2.4). Accordingly, this constraint applies only to time-limited EDTO significant systems which are defined in Section 2.2.3.

3.5.4.1.3 When the ETOPS rules were first published in 1985, it was required to consider only the time capability of the cargo fire suppression system, and this capability had to match the contemplated maximum approved diversion time (ISA, still-air) with an additional 15-minute margin. This margin was deemed to be sufficient to account for operational variances such as winds over the diversion for all operations up to 180 minutes maximum diversion time (ISA, still-air).

3.5.4.1.4 However, for operations beyond 180 minutes maximum diversion time, wind effects for these higher diversion times can be more significant, therefore the traditional 15-minute margin may not be sufficient if the maximum diversion time was not corrected with the actual forecast wind. This is why the concept of consideration of TLSs has been slightly revised with the introduction of the EDTO criteria.

3.5.4.1.5 As before, the aircraft manufacturer should identify the capability of the most time-limiting EDTO significant system which is usually the cargo fire suppression system. However, for aeroplanes with two turbine engines certified under the new criteria, the aircraft manufacturer should also identify the capability of the other most limiting EDTO significant system. (This is not required for aeroplanes with more than two engines.) The corresponding limitations are identified in relevant aeroplane documentation (e.g. for a twin in the EDTO CMP document as well as in the AFM).

Note.— Identification of the other most limiting EDTO significant system is performed by the manufacturer during the EDTO certification of the aeroplane which is not required by ICAO Standards for aeroplanes with more than two engines or for aeroplanes with two turbine engines certified against previous ETOPS Standards. Therefore, for those States that have implemented an EDTO certification criteria for aeroplanes with more than two engines, the time capability of the other most limiting EDTO significant system should also be identified and considered for EDTO operations of these aeroplanes.

3.5.4.1.6 As per the EDTO criteria in Annex 6, these time limitations must be considered by the EDTO operators at time of dispatch, and the way these time limitations have to be considered is slightly different for EDTO up to 180 minutes and for EDTO beyond 180 minutes, as detailed in the following sections.

3.5.4.2 ***EDTO up to 180 minutes (including the 15 per cent operational extension)***

3.5.4.2.1 The time required to fly the distance to the planned EDTO alternate or alternates (including a 15-minute margin for approach and landing) at the approved OEI cruise speed in still-air and standard day temperature, should not exceed the time specified in the AFM (or other relevant aeroplane documentation) for the aeroplane's most TLS(s) time.

3.5.4.2.2 Considering the current rate of cargo fire occurrences (on a passenger-carrying aeroplane) and the rate of engine failure, the probability of a simultaneous cargo fire and engine failure would be extremely remote (in the order of 10^{-13} per flight hour). Therefore, for the cargo fire suppression system, it may be acceptable to consider the AEO cruise speed (instead of the OEI cruise speed) when checking the time required to fly the distance to the planned EDTO alternate or alternates (including a 15-minute margin for approach and landing).

Note.— Initial ETOPS regulations implemented in 1985 required the use of the OEI cruise speed and flight level when checking the cargo fire suppression system time limitation. Consequently, most ETOPS/EDTO certified twin-engine aeroplanes have their cargo fire suppression system sized accordingly. Therefore, for twin-engine aeroplanes, it is acceptable to consider the same approved OEI cruise speed for the check of the aeroplane's most TLS(s) time.

3.5.4.2.3 Figure 3.5-12 illustrates the case of an operator with a 180-minute EDTO authorization. In this example, as stated above, the operator has to check that the time specified in the AFM (or other relevant aeroplane documentation):

a) for the aeroplane's cargo fire suppression system, is equal to or greater than the granted maximum diversion time plus 15 minutes, i.e. 195 minutes in this case; and

b) for the aeroplane's most TLS time (other than cargo fire suppression), if any, is equal to or greater than the granted maximum diversion time plus 15 minutes, i.e. 195 minutes in this case. As explained in Section 3.5.4.1, this check is applicable only to aeroplanes certified against the new EDTO criteria.

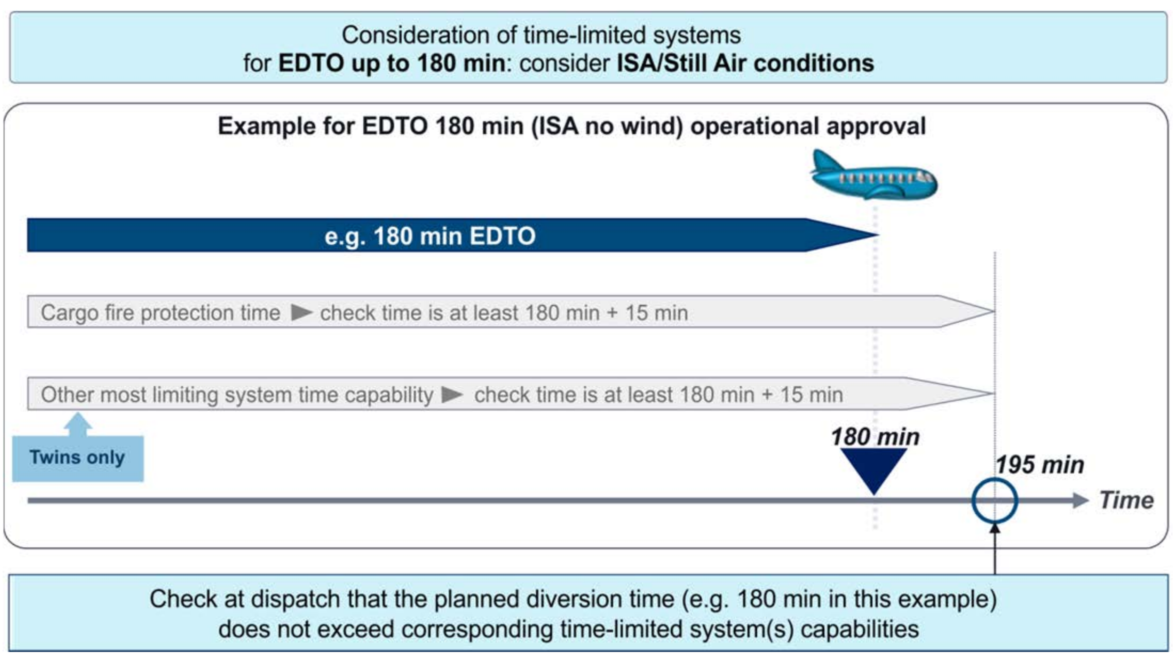

Figure 3.5-12. Time-limited systems considerations for EDTO up to 180 minutes (example for 180 minutes)

3.5.4.2.4 It should be noted that some MMEL/MEL items may reduce the time capability of the EDTO TLS(s) (see also Section 3.5.5.2). These reductions should be taken into account when planning the aircraft on an EDTO sector, to ensure that the aircraft remains within the reduced time limitations as explained above. For example, an inoperative cargo fire suppression bottle would lead to a reduction of the related EDTO TLS capability.

3.5.4.3 ***EDTO beyond 180 minutes***

3.5.4.3.1 A check should be performed at dispatch to confirm that the time required to fly the distance to the planned EDTO alternates (including the 15-minute margin for approach and landing) does not exceed:

a) for all aeroplanes, the time specified in the AFM (or other relevant aeroplane manufacturer documentation) for the aeroplane's cargo fire suppression system, considering a diversion at AEO cruise speed and altitude corrected for forecast wind and temperature; and

b) for twin-engine aeroplanes, the time specified in the AFM for the aeroplane's most TLS time (other than cargo fire suppression), considering a diversion at the approved OEI cruise speed and altitude corrected for forecast wind and temperature.

3.5.4.3.2 Any MMEL/MEL items impacting the capability of the EDTO TLS(s) should be taken into account, and corrected time limitations should be considered when performing this check (see also Section 3.5.5.2).

3.5.4.3.3 Figure 3.5-13 illustrates the case of an operator with a 240-minute EDTO authorization which would result in a given diversion distance based on the approved cruise speed (OEI or AEO as explained in Section 3.2) and flight level in still-air and standard day temperature. Considering the forecast weather conditions (wind and temperature) along the concerned diversion track(s), the operator determines that the time needed to fly the resulting diversion distance is 216 minutes at the AEO speed and FL, and 248 minutes at the OEI speed and FL. Therefore, the operator has to check that the time specified in the AFM (or other relevant aeroplane manufacturer documentation):

a) for the aeroplane's cargo fire suppression system, is equal to or greater than the AEO diversion time plus 15 minutes, i.e. 231 minutes in this case; and

b) for the aeroplane's most TLS time (other than cargo fire suppression), is equal to or greater than the OEI diversion time plus 15 minutes, i.e. 263 minutes in this case. As explained in Section 3.5.4.1, this check is applicable only to aeroplanes with a dedicated EDTO certification.

3.5.4.3.4 Should the time limitation(s) be exceeded, the operator should plan the aeroplane on another track, possibly with a reduced diversion distance, to ensure that the aircraft remains within the relevant system time limitations as described above.

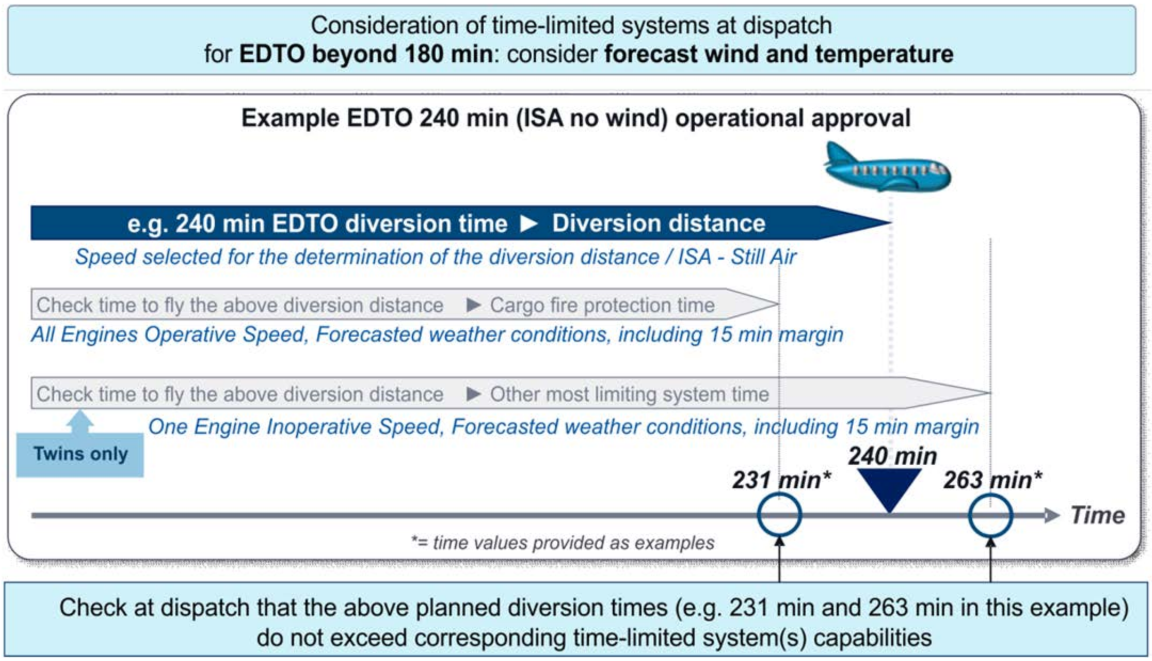

Figure 3.5-13. Time-limited systems considerations for EDTO beyond 180 minutes (example for 240 minutes)

3.5.4.3.5 Figure 3.5-14 provides an example of how the capabilities of the relevant EDTO TLSs may be documented in the AFM for a two-engine aeroplane certified for EDTO beyond 180 minutes. In this AFM example, the time capability of the cargo fire suppression system is stated to be 220 minutes so the maximum planned all-engine diversion time based on forecast weather conditions for EDTO flight preparation purposes would be limited to 205 minutes. In the above dispatch example (Figure 3.5-13), the actual all-engine diversion time was determined to be 216 minutes. This is greater than the example AFM capability minus 15 minutes, so a new dispatch solution would need to established (e.g. re-route and/or closer EDTO alternates) to satisfy the all-engine EDTO TLS diversion planning requirement. The example AFM TLS capability for OEI diversion planning is stated to be 290 minutes, so the actual forecast diversion time must be no greater than 275 minutes. Since the actual OEI diversion time in the dispatch example (Figure 3.5-13) was determined to be only 248 minutes, the OEI TLS planning requirement is satisfied. However, since both the AEO and OEI planning requirements must be satisfied, the dispatch solution would still need to be adjusted to ensure that the calculated all-engine diversion time with consideration for forecast weather conditions is less than or equal to 205 minutes.

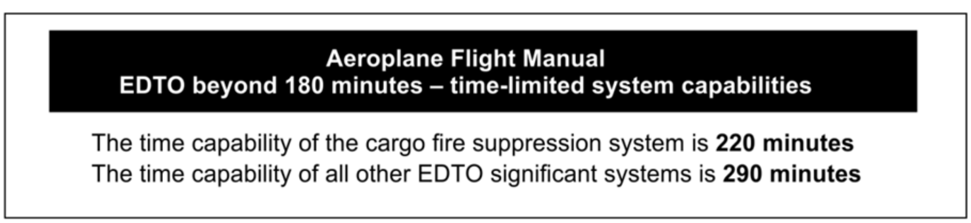

Figure 3.5-14. Example of EDTO time-limited system capabilities in the AFM

3.5.5 EDTO technical status of the aeroplane

3.5.5.1 ***General***

3.5.5.1.1 As per Section 4.7.2 of Annex 6, Part I, it is the responsibility of the operator to ensure that the relevant time limitations of the aeroplane engaged in EDTO operations are not exceeded, and, for aeroplanes with two turbine engines, that the aeroplane is certified and configured for the planned EDTO mission.

3.5.5.1.2 As the time limitations of a given aeroplane may be impacted by the configuration and/or the maintenance programme of the aeroplane, the operator should implement tools and/or procedures to ensure that the relevant EDTO capability and time limitation(s) of the aeroplane dispatched are compatible with the contemplated EDTO flight, as explained in Section 3.5.4.

3.5.5.1.3 In addition, as explained in Chapter 2, the EDTO certification of the aeroplane entails the issuance of an EDTO CMP document, which provides the required configuration, maintenance, procedures and dispatch standards. For EDTO operations, the aircraft should therefore be configured, maintained and operated according to the EDTO CMP document requirements. This means that the operator should implement tools and/or procedures to track any aeroplane discrepancies that may impact the EDTO serviceability and operational capability of the aeroplane.

Note.— As explained in Section 2.1.5, the basic type certification standards and maintenance programme of aeroplanes with more than two engines provide the required level of safety intended for EDTO and are suitable for EDTO operations. Accordingly, the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines. Therefore, in this case the EDTO status of aeroplanes with more than two engines is directly linked to the status of the relevant TLS. In other words, only maintenance or configuration changes to the relevant TLS may impact the EDTO status of aeroplanes with more than two engines.

3.5.5.1.4 An EDTO maintenance release statement should provide the flight crew with the assurance that:

a) the aircraft condition has been checked and confirmed to comply with the applicable EDTO dispatch requirements set forth in the company policies and applicable MEL;

b) the EDTO items of the applicable maintenance line check have been accomplished;

c) the aircraft configuration has been checked and confirmed to comply with the applicable configuration standards set forth in the EDTO CMP document (as applicable); and

d) the capability of relevant TLS(s) has been assessed.

3.5.5.1.5 The EDTO maintenance procedures manual (or equivalent) should define the content of the EDTO service check and the procedures associated with the EDTO maintenance release (see also Chapter 4).

3.5.5.2 ***Maintenance release — twin-engine aeroplanes***

3.5.5.2.1 The EDTO status of the aeroplane should be confirmed before each EDTO flight. For that purpose, an EDTO release statement should be provided to the flight dispatcher by the relevant operator maintenance organization (typically the maintenance control centre) for operational control and flight preparation purposes. This EDTO status of the aeroplane depends on:

a) the certified EDTO capability of the aeroplane;

b) the configuration of the aeroplane versus the applicable configuration requirements of the EDTO CMP document;

c) the compliance of the aeroplane versus the applicable maintenance requirements of the EDTO CMP document;

d) the capability of relevant TLS(s); and

e) any inoperative system (MEL).

3.5.5.2.2 The relevant maintenance organization (typically the maintenance control centre) of the operator should issue this EDTO maintenance release statement as part of the maintenance release (e.g. certificate of release to service) of the aeroplane. This EDTO maintenance release statement, which is typically included in the aircraft maintenance logbook, should clearly indicate:

a) whether the concerned aeroplane is EDTO capable (yes or no); and

b) the related maximum diversion time capability.

3.5.5.2.3 The flight dispatcher should carefully consider this information when preparing an EDTO flight for a given aeroplane, in order to ensure that the aeroplane will be dispatched within its EDTO capability.

3.5.5.2.4 Figures 3.5-15 and 3.5-16 are typical examples of EDTO release statements for two-engine aeroplane EDTO operations up to 180 minutes.

3.5.5.2.5 As shown in Figure 3.5-15, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO; and

b) its maximum diversion time is 120 minutes (approved OEI speed/ISA/no wind).

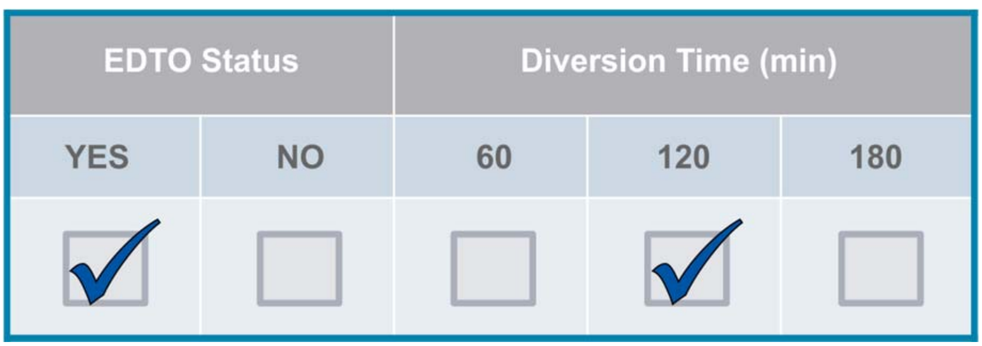

Figure 3.5-15. Example of EDTO release statement (120 minutes)

3.5.5.2.6 As shown in Figure 3.5-16, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is restricted to non-EDTO operations; and

b) accordingly, its maximum diversion time is 60 minutes (OEI speed/ISA/no wind).

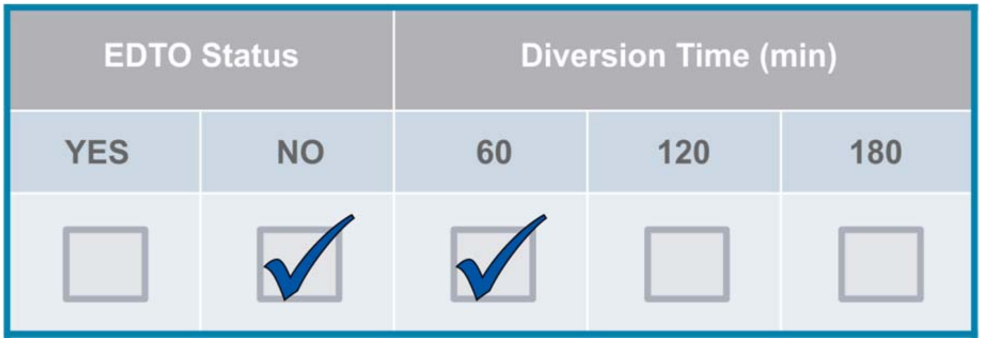

Figure 3.5-16. Example of EDTO release statement (60 minutes)

3.5.5.2.7 As explained in Section 3.5.4.3, for EDTO operations beyond 180 minutes the operator has to check that the diversion flight times (plus 15 minutes) along the planned flight track do not exceed the time specified in the AFM (or other relevant aeroplane manufacturer documentation):

a) for the aeroplane's cargo fire suppression system, considering a diversion at the AEO speed and altitude; and

b) for the aeroplane's most TLS time (other than cargo fire suppression), considering a diversion at the OEI diversion speed and altitude.

3.5.5.2.8 Therefore, a dedicated process for the check and tracking of the time capability of the relevant EDTO TLS(s), if any, should be implemented in order to ensure that this information is adequately provided by the relevant maintenance organization (typically the maintenance control centre) of the operator, and taken into consideration by the flight operations organization (dispatchers and flight crews).

3.5.5.2.9 This may be done by including in the EDTO release statement the necessary check boxes for each of the possible values of time capability of the relevant TLS(s). The corresponding values should be updated, as part of the aeroplane's maintenance release, any time there is a situation impacting the time capability of the concerned TLS(s), e.g. in case of:

a) the system being inoperative;

b) the system being replaced by another with a lesser/greater time capability; and

c) maintenance action impacting the time capability of the system.

3.5.5.2.10 Figure 3.5-17 provides a typical example of an EDTO release statement for EDTO operations beyond 180 minutes. As shown in this example, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO beyond 180 minutes;

b) its maximum OEI diversion time is 325 minutes (340 minutes – 15 minutes), at the OEI speed, considering forecasted wind and temperature; and

c) its maximum AEO diversion time is 235 minutes (250 minutes – 15 minutes), at the AEO speed, considering forecasted wind and temperature.

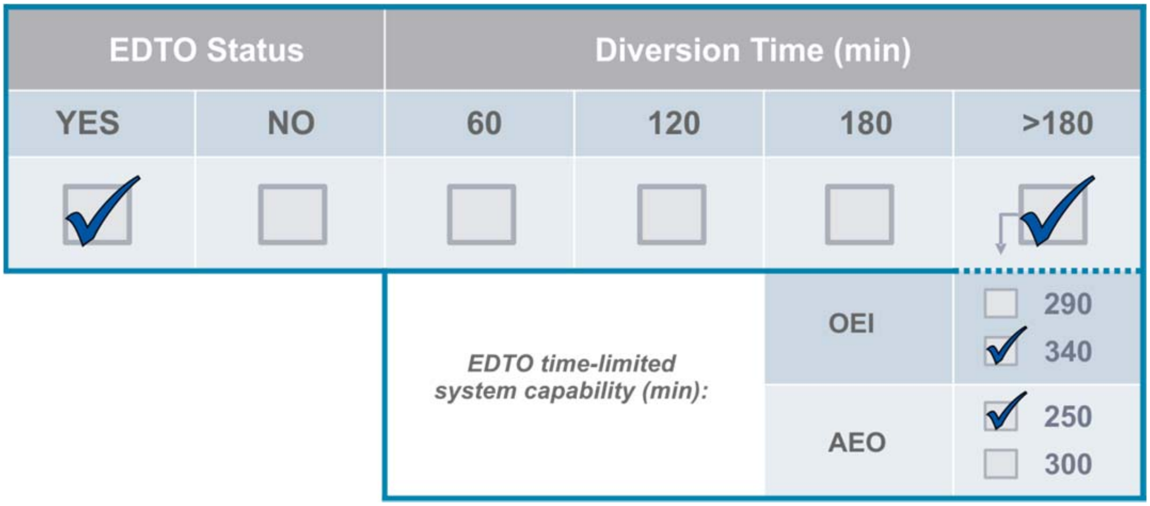

Figure 3.5-17. Example of EDTO release statement (EDTO beyond 180 minutes)

3.5.5.3 ***Maintenance release — aeroplanes with more than two engines***

3.5.5.3.1 As discussed in Section 2.1.5, it has been confirmed that for aeroplanes with more than two engines, both the basic type certification standards and maintenance programme provide the required level of safety for EDTO and are suitable for EDTO operations. Accordingly, the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines. Nevertheless, it has also been concluded that a review of the time limitation of relevant TLSs, if any, is necessary for aeroplanes with more than two engines engaged in EDTO.

3.5.5.3.2 Therefore, the EDTO status of aeroplanes with more than two engines is linked to the status of the relevant TLS. In other words, only maintenance or configuration changes to the relevant TLS may impact the EDTO status of aeroplanes with more than two engines.

3.5.5.3.3 Per definition, the number of items that may impact this EDTO status should be very limited, and it may therefore not be necessary to implement a process for EDTO release statement as for twin-engine aeroplanes. Typically, the impact of an unserviceable TLS (e.g. an inoperative cargo fire suppression bottle) could be handled through the existing deferred defect list, and the related diversion time limitation should be duly taken into consideration when planning the EDTO flight, as for any other MEL items.

3.5.5.3.4 Regardless, a system of EDTO release statements may still be implemented to facilitate the management of this EDTO status. Figure 3.5-18 provides an example of an EDTO release statement adapted to aeroplanes with more than two engines (assuming that the EDTO threshold has been set at 180 minutes).

3.5.5.3.5 As shown in Figure 3.5-18, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO; and

b) its maximum AEO diversion time is 285 minutes (300 minutes – 15 minutes), at the approved AEO speed, considering forecasted wind and temperature.

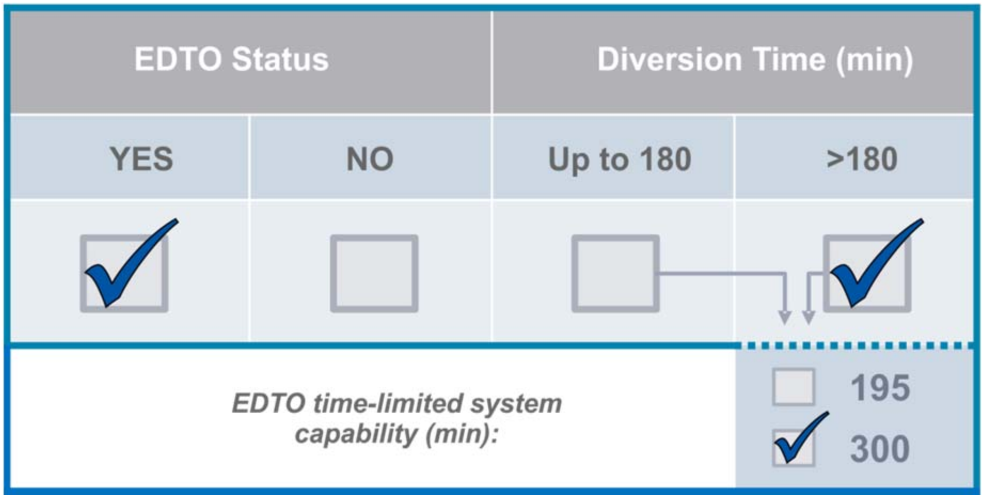

Figure 3.5-18. Example of EDTO release statement (aeroplanes with more than two engines)

3.5.5.3.6 In Figure 3.5-19, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is restricted to non-EDTO operations; and

b) its maximum AEO diversion time is 180 minutes (195 minutes – 15 minutes), at the approved AEO speed (ISA/no wind).

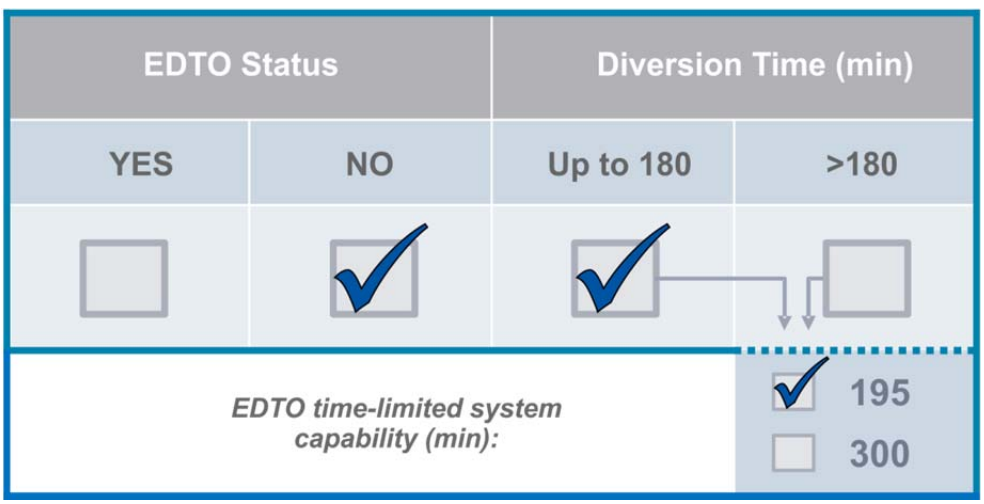

Figure 3.5-19. Example of non-EDTO release statement (aeroplane with more than two engines)

3.5.5.4 ***Minimum equipment list (MEL)***

3.5.5.4.1 *General*

3.5.5.4.1.1 The operator's MEL should be developed based on the MMEL provided by the aeroplane manufacturer. The MMEL, which is approved by the State of Design in accordance with Annex 6, Part I, may be customized by the operator as a function of its operational policies and considering relevant national operational requirements. The State of the Operator should take the necessary steps to ensure that an EDTO operator's MEL complies with all applicable requirements for the relevant aeroplane fleet type(s) and approved EDTO maximum diversion time capability.

3.5.5.4.1.2 The operator's MEL should also consider the specificities of the EDTO area of operation, such as:

a) maximum diversion time;

b) availability of en-route alternate aerodromes, and available facilities and equipment;

c) navigation and communication means; and

d) prevailing meteorological conditions.

3.5.5.4.1.3 The MMEL may include restrictions that are specific to EDTO operations. For example, a given MMEL item may require re-routing of the flight to remain within a lower maximum diversion time or even restrict the operation to a non-EDTO route as necessary. These specific requirements for EDTO flights must be clearly identified in the operator's MEL, and the operator's MEL cannot be less restrictive than the MMEL as appropriate to the approved maximum diversion time.

3.5.5.4.1.4 The EDTO restrictions of the MMEL/MEL may be related to:

a) the allowable maximum diversion time;

b) the capability of the TLS(s); and

c) the applicable weather minima.

Note.— MMEL documents may use different terms in some cases to describe EDTO dispatch restrictions. For example, the term "ER" may be used to represent EDTO within the context of the MMEL/MEL or a flight time restriction to landing at an alternate aerodrome may be imposed without a specific reference to EDTO.

3.5.5.4.2 *MEL with EDTO restrictions related to maximum diversion time*

These EDTO restrictions are typically related to the number of equipment or systems required to be operative at dispatch for a flight with a given maximum diversion time. These restrictions may typically be formulated as follows:

a) "May be inoperative provided that EDTO is not conducted", i.e. the aeroplane should be restricted to non-EDTO flights only; or

b) "May be inoperative provided that EDTO beyond xxx minutes is not conducted", i.e. the aeroplane should not be dispatched on a flight with a diversion time above xxx minutes.

3.5.5.4.3 *MEL with EDTO restrictions related to TLSs*

These EDTO restrictions are typically related to components or equipment of the EDTO TLS(s), which may reduce the time capability of the system when they are degraded or inoperative (e.g. the cargo fire suppression system). These restrictions may typically be formulated as follows:

a) "May be inoperative provided that EDTO beyond xxx minutes is not conducted", i.e. the aeroplane should not be dispatched on a flight with diversion time above xxx minutes; or

b) "May be inoperative provided that operations beyond xxx minute diversion time are not conducted."

3.5.5.4.4 *MEL with EDTO restrictions related to weather minima*

3.5.5.4.4.1 These EDTO restrictions are typically related to components or equipment necessary in the conduct of satellite-based or ground-based instrument approaches. There may be MEL limitations affecting the instrument approach capability of the aeroplane. In this case, those MEL limitations affecting instrument approach capability should be considered in assessing the EDTO alternate aerodrome minima (see 3.5.2.4). The operator's EDTO flight preparation procedures should ensure that aeroplane's approach capability including any MEL restrictions will meet the EDTO dispatch weather minima requirements for the designated EDTO alternate aerodromes.

3.5.5.4.4.2 These restrictions may typically be formulated as related to the aeroplane's approach capability and not necessarily connected to EDTO:

"May be inoperative provided approach minima do not require its use", i.e. the aeroplane's ability to conduct low visibility approaches is impacted.

3.6 IN-FLIGHT CONSIDERTATIONS

3.6.1 General

Most EDTO unique flight operations requirements are addressed in the EDTO flight preparation process (Section 3.5). The additional in-flight considerations for EDTO primarily consist of enhanced awareness of aeroplane system and fuel status, and monitoring of EDTO alternate aerodrome conditions to ensure a safe approach and landing during a potential EDTO diversion. Normal and non-normal aeroplane operating procedures are typically equally applicable to both EDTO and non-EDTO operations and are validated by the manufacturer to support EDTO during the certification process, if required. Other concurrent en-route operational considerations such as long-range navigation, long-range communication and airspace constraints (e.g. RVSM, MNPS, RNP) are also equally applicable to both EDTO and non-EDTO flights within a given operational area.

Note 1.— In-flight considerations for EDTO are separate but complementary to the flight preparation considerations discussed in Section 3.5. The pilot-in-command is not bound by the EDTO planning assumptions and may exercise discretionary authority to deviate from these assumptions in the event of an in-flight emergency.

Note 2.— The in-flight assessment criteria for fuel, aeroplane system and EDTO alternate weather status differ from the assessment criteria used for EDTO flight preparation. These differences are noted where applicable in the remainder of this section.

3.6.2 In-flight monitoring

3.6.2.1 ***Communication/Navigation***

3.6.2.1.1 EDTO operations typically include route segments which are outside the range of ground-based navigation and communication aids, and therefore long-range navigation and communication capability is generally required to support these operations. The requirement for long-range communication/navigation capability is, for the most part, not specifically connected to EDTO, but may be concurrent with an EDTO operation depending on the particular en-route airspace environment.

3.6.2.1.2 EDTO operators should establish procedures and minimum equipment requirements for the long-range navigation airspace regions of their approved EDTO areas of operation. This would typically include dual independent long-range navigation systems installed on the aeroplane, MEL equipment considerations, flight crew position monitoring and/or plotting procedures and contingency procedures in the event of a loss of long-range navigation capability. Long-range communication requirements are typically satisfied with dual high frequency (HF) radio installations and may also be supplemented with satellite-based voice and/or datalink communication systems. In addition to being able to communicate with oceanic control centres while en-route, EDTO communication capability should also consider the capability to communicate with the operator's maintenance and operations control facilities in the event that assistance is needed by the flight crew to manage a non-normal en-route situation. This company communication capability may be addressed in several ways including contracting with radio service providers, communication patches or relays and/or a dedicated operator HF station.

3.6.2.1.3 Some additional communication and navigation considerations for EDTO include the following:

a) for all EDTO operations where voice communication facilities are available, voice communication should be provided. While planning an EDTO flight, an operator should consider potential route and altitudes necessary for diversion to EDTO alternate aerodromes in determining whether voice communications facilities are available. Where voice communication facilities are not available or are of poor quality and voice communication is not possible, communications using an alternative system should be substituted;

b) for EDTO operation beyond 180 minutes, the aeroplane should be equipped with an additional communication system that is capable of providing immediate satellite-based voice communication. The system should provide communication capability between the flight crew and air traffic control, and between the flight crew and the air operator's operational control centre. While planning an EDTO flight beyond 180 minutes, an air operator should consider potential route and altitudes necessary for diversion to EDTO alternate aerodromes to determine whether immediate, satellite-based voice communications are available. Where immediate, satellite-based voice communications are not available or are of poor quality, communications using alternative system should be substituted;

c) communication facilities are available to provide reliable two-way communications between the aeroplane and the appropriate ground communication facility over the planned route of flight and the routes to any EDTO alternate aerodrome to be used in the event of a diversion. It should be shown that current weather information, adequate status monitoring information and crew procedures for all aeroplane and ground facilities' critical systems are available to enable the flight crew to make go/no-go and diversion decisions;

d) non-visual ground aids are available and located so as to provide, taking account of the navigation equipment installed in the aeroplane, the navigation accuracy required over the planned route and altitude of flight, and the routes to any alternate aerodrome and altitudes to be used in the event of a diversion; and

e) visual and non-visual aids are available at the specified EDTO alternate aerodromes as required for the authorized types of approaches and operating minima.

3.6.2.2 ***Alternate aerodrome status (weather minima)***

3.6.2.2.1 Once the flight is dispatched, the flight crew and the flight dispatcher should remain informed of any significant changes at the EDTO alternate aerodromes and should be updated with the latest weather and aerodrome information.

3.6.2.2.2 Prior to proceeding beyond the EEP, the pilot-in-command and the flight dispatcher should complete a review of all the EDTO alternate aerodromes identified on the operational flight plan and should ensure that the forecast weather is equal to or exceeds the published operating minima for the expected runway and approach procedure during the applicable validity period (Section 3.5.2.3). For cases where the weather forecast does not meet the required published operating minima for landing, the flight plan should be amended where possible to include another EDTO alternate aerodrome (i.e. one which does meet the landing minima requirements) within the maximum authorized EDTO diversion time and within the aeroplanes EDTO TLS capability. If this cannot be done, the EDTO area of operation is compromised and the flight should continue as non-EDTO.

Note.— The in-flight EDTO alternate weather check prior to proceeding beyond the EEP is not the same as the flight preparation weather minima check described in Section 3.5.2.3. The in-flight check is based on published operating minima whereas the flight preparation check is based on the more conservative EDTO dispatch planning minima.

3.6.2.2.3 Once the flight has entered the EDTO area of operation, if the forecast for any of the designated EDTO alternate aerodromes is revised to below the landing limits or the EDTO alternate aerodrome becomes inadequate, the EDTO flight may continue at the pilot-in-command’s discretion.

Note.— Despite the above consideration, it is good practice for the flight crew to continue to monitor the status of the EDTO alternate aerodromes after the flight has entered the EDTO sector. This is typically done for the next primary alternate when approaching an EDTO ETP.

3.6.2.3 ***Fuel progress monitoring***

3.6.2.3.1 As with any flight, it is important for the flight crew to monitor and maintain awareness of the fuel state of the aeroplane. This is particularly critical for an EDTO flight, given the potential for a long diversion to the nearest en-route alternate aerodrome.

3.6.2.3.2 As previously discussed in Section 3.5.3, the EDTO critical fuel calculation, which is an integral element of the EDTO flight preparation process, is intended to ensure that the planned fuel load is sufficient to support an en-route diversion from the most critical EDTO ETP critical point (CP) in the event of an engine failure, a depressurization, or both, with appropriate planning allowances. This does not preclude the importance of en-route fuel progress monitoring, which is complementary to the flight preparation process. EDTO operators should develop appropriate en-route procedures for flight crews to track actual versus planned fuel burn on the operational flight plan (OFP) and appropriate contingency procedures in the event that the fuel state of the aeroplane becomes unacceptable to complete the intended mission. The importance of adhering to these procedures should be addressed in the EDTO training programme which is discussed in Section 3.7.

3.6.2.3.3 The EDTO critical fuel calculation (Section 3.5.3) is strictly a flight preparation consideration and does not apply once en-route, as operational variances such as more adverse winds than forecast may result in actual fuel burns which differ from the assumptions used to produce the OFP. EDTO operators should develop a minimum en-route fuel policy as the basis for the flight crew to determine if the fuel remaining on the aeroplane is sufficient to complete the mission. It is not necessary for the calculated critical fuel to be on board when passing the EDTO ETPs including the CP provided these en-route policy reserves are satisfied.

Note.— Standards for in-flight fuel management including minimum fuel are provided in Section 4.3.7 of Annex 6, Part I.

3.6.2.4 ***Procedures to support EDTO maintenance programme***

3.6.2.4.1 *General*

3.6.2.4.1.1 While the EDTO programme requirements for flight operations and maintenance are discussed in Chapters 3 and 4, there is a necessary interface or connection between the two programmes in certain areas of shared responsibility. These programme interfaces should be addressed in EDTO flight operations manual (FOM) procedures (Section 3.8) and training programmes (Section 3.9) to ensure that all affected departments and personnel understand their roles in supporting the EDTO operation. Specific areas where EDTO flight operations procedures may be implemented to support the EDTO maintenance programme are addressed in the remainder of this section.

Note.— As explained in Sections 2.1.5 and 4.1.1, there are no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines. Although an operator may consider as good practice for its operations with aeroplanes with more than two engines some elements detailed in this section, it is primarily intended for and applicable to EDTO operations of twin-engine aeroplanes only.

3.6.2.4.2 *Auxiliary power unit (APU) in-flight start programme*

3.6.2.4.2.1 States may establish a requirement for EDTO operators to monitor the in-flight start performance of the APUs installed on their EDTO fleets as part of the EDTO reliability programme (Sections 4.10 and 4.16). Where an APU in-flight start programme is required, the sampling intervals and reliability tracking procedures are established under the EDTO maintenance programme. The primary role of flight operations is to actually execute the in-flight start attempts when directed and to record the success or failure for appropriate maintenance action. Specific procedures to address the flight operations role should include:

a) notification of APU in-flight start requirement to flight crews through the flight release process;

b) in-flight start instructions including number of start attempts, allowable altitudes and time required in cruise (cold soak) before initiating start attempts; and

c) documentation procedures for recording success or failure of start attempts.

Note.— The APU in-flight start sampling programme (where required) is in addition to cases where the APU must be started and running to support EDTO operations due to aeroplane configuration architecture, in-flight verifications, MEL status or en-route failure conditions.

3.6.2.4.3 *Maintenance verification flights*

3.6.2.4.3.1 The EDTO maintenance verification programme (Section 4.12) is typically accomplished through positive system verification on the ground using procedures provided by the aeroplane manufacturer. There are, however, cases where an EDTO significant system fault resolution may require in-flight verification through monitoring or exercising of the system by the flight crew. These cases are relatively infrequent, but may occur if a fault is dependent upon specific en-route conditions such as temperature or altitude.

3.6.2.4.3.2 EDTO operators should establish flight operations procedures to address maintenance verification flights when required to include the following:

a) identification of verification flight requirement through the operational control and flight release process;

b) instructions to flight crew to identify the affected system(s) and what should be monitored or exercised; and

c) recording and coordination procedures following success or failure of system verification.

3.6.2.4.3.3 An EDTO verification flight may be accomplished during an EDTO flight (e.g. prior to entering the EDTO sector) or a non-EDTO flight or on a dedicated non-revenue flight. The latter option is rarely used but is an option in meeting the requirement.

3.6.2.4.4 *EDTO significant system discrepancies*

3.6.2.4.4.1 EDTO significant systems are defined in Section 2.2.3 and their applicability to the EDTO maintenance programme is addressed in Section 4.6. The application to the EDTO flight operations programme is often confused because some systems identified as EDTO significant for maintenance programme purposes may also have flight preparation and/or en-route implications. As such, EDTO operators should clearly establish the relevance of system discrepancies to the respective areas in their EDTO programme documentation.

3.6.2.4.4.2 The "EDTO significant systems list" is developed by the operator (typically based on aeroplane manufacturer guidance) and approved by the State of the Operator as an integral component of the EDTO maintenance programme. This list is applicable to the EDTO reliability (Section 4.10) and EDTO verification programmes (Section 4.12). The EDTO significant systems list is not intended for en-route purposes or for flight preparation purposes except as provided by the MEL.

3.6.2.4.4.3 Aeroplane systems which have EDTO flight preparation or flight release implications are a separate consideration from the EDTO significant systems list and should be addressed in the operator's MEL as discussed in Section 3.5.5.4. The MEL EDTO restrictions are typically based on the MMEL issued by the State of Design, which supports the certified EDTO capability of the aeroplane. Additional EDTO flight release restrictions may be included in the operator's MEL to reflect the specifics of the authorization. The MEL should also include guidance on system failure responses after pushback and prior to take-off.

3.6.2.4.4.4 En-route flight crew responses to non-normal aeroplane system conditions are a separate consideration from the EDTO maintenance programme and flight release procedures. Non-normal conditions and flight crew procedures which call for a technical diversion are provided by the aeroplane manufacturer in the quick reference handbook (QRH) or by other methods (e.g. electronic checklists). These procedures are validated during the EDTO certification of the aeroplane and are typically common to both EDTO and non-EDTO operations.

3.6.2.4.5 *EDTO flight release after non-technical diversions*

The release of an EDTO flight typically requires completion of an EDTO service check performed by properly qualified maintenance personnel (Section 4.9). Qualified maintenance personnel may not, however, be available on-site following a non-technical diversion to an en-route alternate aerodrome from which a subsequent EDTO flight release is required. For such situations, EDTO operators may establish procedures to allow flight crews to accomplish the flight release by coordinating remotely with EDTO maintenance personnel. The roles, responsibilities and qualifications of involved personnel should be consistent with State requirements and should be clearly identified in the operator's EDTO procedures documentation.

3.6.3 Diversion considerations

3.6.3.1 ***General***

3.6.3.1.1 Many of the potential scenarios that could lead to an EDTO en-route diversion are events that rarely happen. However, like all the other events that could occur during flight, the flight crew should be prepared to handle the situation safely and effectively.

3.6.3.1.2 A key element of being well prepared for an EDTO diversion is the preflight briefing where possible areas of concern can be reviewed and the potential plans of action communicated to all members of the flight crew without the added stress of required immediate action. A review of the weather and terrain along possible EDTO diversion tracks should ensure that the crew has a common plan for handling possible contingencies. On long flights, with crew members transitioning from a duty station to crew rest and back, it is important that standard operating procedures be followed to minimize any possible confusion about the aeroplane's position relative to EDTO ETPs and the direction of turn required to proceed to the nearest designated en-route alternate aerodrome on the operational flight release.

Note.— The EDTO alternate aerodromes determined during the EDTO flight preparation process provide one potential course of action in the event of an en-route diversion; however, the flight crew is not bound by the dispatch assumptions and may select another diversion aerodrome if determined to be more suitable for the prevailing operational conditions.

3.6.3.2 ***Diversion decision-making***

3.6.3.2.1 It is not possible to cover every combination of circumstances that might occur during a diversion so operator guidance to flight crews may be general only. It is left up to the judgment of the flight crew to conduct the flight in the safest manner possible in light of the prevailing operational conditions that exist at the time.

Note.— The specific guidance provided by EDTO operators to their flight crews may also include the details of terrain clearance or oxygen limited escape route policies and procedures which the operator has established. Terrain clearance and oxygen requirements are generally independent of EDTO and should be covered as needed in other applicable sections of the operator's operations manual.

3.6.3.2.2 There are a number of events that might prompt the flight crew to consider diverting on an EDTO flight. Some of these events are "technical" in nature and are addressed by non-normal procedures established by the aeroplane manufacturer which are generally common to all (EDTO and non-EDTO) operations. Typical examples of these technical events might include an engine failure or fire, cabin fire or smoke, decompression, multiple loss of AC power sources, multiple loss of hydraulic system power sources, a cargo fire or any other relevant "technical" situation that may have an adverse effect on the safety of flight.

Note.— Flight crew guidance and checklists for en-route technical failures including technical diversion criteria are provided by the aeroplane manufacturer in the aeroplane operating manual or through other methods (e.g. electronic checklists). The aeroplane operating manual thus provides the basis of technical diversion decision-making, as opposed to the MEL (Section 3.5.5.4) or EDTO significant systems list (Section 4.6) which are intended for use on the ground and are not relevant to en-route operations.

3.6.3.2.3 However, the vast majority of diversions that have occurred in actual EDTO service have been due to non-technical causes. Passenger and crew medical emergencies, adverse en-route weather conditions or EDTO alternate aerodromes becoming unavailable may also result in a diversion or air turn back. The nature of the emergency and its possible consequences to the aeroplane, passengers and crew will dictate the best course of action suitable to the specific situation. The flight crew must decide on the best course of action based on all available information. Operator procedures documentation and training programmes should support this decision-making process.

3.6.3.2.4 As noted above, the EDTO alternate aerodromes listed in the flight release for a particular EDTO flight provide one diversion option to the pilot-in-command, as do the selected EDTO diversion planning speeds established by the operator. However, the EDTO alternates selected at dispatch may not be the only aerodromes available for the diversion and the EDTO OEI or AEO speeds used at the planning stage may not be the best choice for a particular circumstance. Operator policy should specify the authority of the pilot-in-command to deviate from these dispatch planning parameters in the event of an actual EDTO diversion.

3.6.3.3 ***Diversion strategies***

3.6.3.3.1 Once the need for an EDTO diversion has been established and an en-route alternate aerodrome selected, the flight crew will need to consider how to actually conduct the diversion based on the nature of the emergency and prevailing operational considerations. Non-technical diversions or technical diversions which do not have a significant impact on the performance of the aeroplane would normally be performed at a typical cruise flight condition or at a higher all-engine cruise speed to minimize the diversion time as permitted by the aeroplane’s fuel state.

3.6.3.3.2 For an engine failure diversion, the consequences of speed selection on the aeroplane’s performance (e.g. fuel, altitude) can be significant particularly for a two-engine aeroplane. As such, it is important for the flight crew to understand these consequences and to have appropriate guidance to choose the safest and most appropriate diversion strategy. Typically, there are three primary considerations to determine the best course of action from the standpoint of OEI speed selection which may be described as follows:

- **Time strategy:**

  If minimum diversion time and getting the aeroplane on the ground as soon as possible are the most critical considerations, a high OEI speed strategy may be selected as permitted by the aeroplane’s fuel state, altitude capability and structural integrity. For two-engine aeroplanes, the time strategy is sometimes considered to be equivalent to the approved OEI speed, but a higher speed approaching VMO/MMO could be selected if conditions warrant. The flight crew is not bound by the speed assumptions used for EDTO flight preparation purposes (Section 3.5).

- **Fuel strategy:**

  If the fuel remaining to accomplish the diversion is the most critical consideration, OEI long-range cruise (LRC) speed or even maximum range cruise (MRC) speed could be selected to optimize fuel management during the diversion. EDTO critical fuel planning (Section 3.5.3) will generally preclude the possibility of a fuel-critical EDTO diversion; however, fuel may nevertheless be a primary consideration in managing the diversion.

- **Obstacle strategy:**

  If the diversion track following engine failure will traverse high terrain, additional care should be taken in speed selection to ensure that en-route terrain clearance margins are maintained. The speed associated with maximum lift over drag ratio (L/Dmax) will provide the best OEI altitude performance and should be selected until clear of any limiting terrain.

3.6.3.3.3 Diversion decision-making and strategy considerations should be addressed in EDTO flight crew training programmes and procedures documentation. Aeroplane type specific information should be included such as flight management system (FMS) functionality to support a diversion and available engine inoperative performance data (e.g. altitude capability, diversion fuel, power setting) as implementations may vary for different EDTO fleets. The EDTO flight preparation assumptions (Section 3.5) and associated margins as relate to en-route diversion strategy considerations should also be addressed.

3.7 AEROPLAN PERFORMANCE DATA

3.7.1 An aeroplane should not be released on an EDTO flight unless the air operator's operations manual and/or as applicable the EDTO flight operations manual (EFOM) (see 3.8) contain(s) sufficient performance data to support all phases of any applicable EDTO operation, including flight preparation and en-route operations. The performance data should be based on information provided or referenced in the approved aeroplane flight manual (AFM) or from other operational documentation or software tools provided by the aeroplane manufacturer.

3.7.2 The following aeroplane performance data should be available to support EDTO flight and en-route operations as discussed in Sections 3.5 and 3.6, respectively:

a) EDTO area of operations (diversion distance);

b) detailed OEI performance data for standard and non-standard atmospheric conditions covering:

   1) driftdown (includes net performance);

   2) cruise performance (altitude coverage including 3 000 m (10 000 ft));

   3) fuel requirements;

   4) altitude capability (includes net performance); and

   5) holding;

c) detailed AEO performance data, including nominal fuel flow data, for standard and non-standard atmospheric conditions covering:

   1) cruise performance (altitude coverage including 3 000 m (10 000 ft)); and

   2) holding;

d) details of any other conditions relevant to EDTO flight preparation including fuel used for thermal anti-ice, ice accretion on the unprotected surfaces of the aeroplane, and APU usage, as appropriate.

3.8 EDTO FLIGHT OPERATIONS MANUAL (EFOM)

3.8.1 Background

3.8.1.1 The operator should include EDTO information in the relevant part(s) of the basic FOM or publish this information as a "stand alone" EDTO flight operations manual (EFOM).

Note.— The EFOM terminology may vary in different operator programmes or State regulations.

3.8.1.2 This EFOM or the EDTO content of the basic FOM define EDTO flight operations practices supporting these operations as well as responsible persons and/or organizations. The manual should include, either directly or by reference to incorporated documents, the requirements described in Chapter 3.

3.8.2 Purpose

3.8.2.1 The purpose of the EFOM (or EDTO content of the basic FOM) is to provide involved personnel and EDTO authorized persons with a descriptive means aimed at ensuring safe and efficient EDTO operations.

3.8.2.2 Accordingly, all EDTO requirements, including supportive programme procedures, duties and responsibilities, should be identified as being related to EDTO. The EFOM should be submitted to the FOI for review and authorization by specific approval with sufficient lead-time prior to the scheduled commencement of EDTO operations of the particular aeroplane type, model or variant (AEC).

3.8.2.3 The EFOM (or EDTO content of the operations manual) should typically address the following topics:

a) general information on applicable EDTO rules and the operator's EDTO programme;

b) scope of operator's EDTO authorization (routes, fleet, diversion time(s) and speed(s), etc.);

c) EDTO flight planning considerations;

d) EDTO en-route considerations; and

e) EDTO training.

3.8.3 Revision control

Revisions to this EFOM (or EDTO content of the basic FOM) should be reviewed and approved as applicable by the FOI for major changes to the programme. However, minor administrative revisions may not require formal review, acceptance or approval by the FOI.

3.9 EDTO TRAINING PROGRAMME

3.9.1 General

3.9.1.1 An operator's flight operations personnel should complete approved training on EDTO prior to the operator receiving an EDTO authorization. Flight crews, dispatchers and other relevant flight operations personnel should be trained in the appropriate background in EDTO regulations and processes and the operator's specific EDTO procedures in order to properly support the operation. An operator's training programme should take into consideration the background and experience of the personnel being trained. Changes in EDTO regulations and operator policy related to the EDTO operation should be emphasized on a regular basis. This may be included in regular recurrent training or through circulation of printed training material, as applicable.

3.9.1.2 EDTO training programmes should include the specific regulations, authorizations (fleets, operational areas), policies, procedures and documentation related to the particular EDTO operation and therefore they can vary in both content and delivery. One EDTO operator may, for example, employ computer-based training (CBT) resources for EDTO academic training while another may elect to use classroom instruction or a combination of both. The duration of initial EDTO training programmes may vary as may the frequency and content of recurrent training.

3.9.1.3 What is important from the standpoint of EDTO flight operations training programme acceptance (or approval, if relevant) is that the programme be well defined and well suited to support the nature and specificity of the particular EDTO operation(s). Flight crew training programmes should include the content and duration of academic training, simulated flight demonstrations, line checks and currency requirements. Dispatcher training programmes should also address academic training considerations as well as the specific tools and methods used for EDTO flight preparation. Some operators may choose to combine the academic training sections for flight crews and dispatchers to promote a better understanding of how the respective functions support the EDTO programme.

Note.— EDTO operators should establish a system to track and identify the EDTO training status of their flight operations personnel to ensure that all personnel supporting the EDTO operations have completed the approved training programme and have satisfied any currency requirements.

3.9.2 EDTO flight operations academic training

The following academic curriculum elements should be addressed in an operator's EDTO training programme for flight operations personnel as applicable to the particular operation. Typically, an instructor-led CBT or combined course of up to half a day is sufficient to address the basic training requirements but this may be extended if warranted for the particular circumstances. The curriculum elements are considered relevant and applicable for both flight crews and flight dispatch personnel in a combined training programme, but may have different degrees of emphasis in the flight preparation and en-route areas if separate programmes are tailored for each audience.

- Familiarity with ICAO EDTO Standards and relevant State regulations
- EDTO operational programme acceptance(s)
    - EDTO fleet(s)
    - EDTO area(s) of operations
    - EDTO threshold(s), maximum diversion time(s) and speed(s)
- EDTO flight planning considerations
    - EDTO area(s) of operations
    - Alternate aerodromes for EDTO
    - EDTO fuel reserves
    - TLS considerations
    - EDTO technical status and MEL considerations
    - EDTO flight release and computer flight plan
- EDTO en-route considerations
    - Standard operating procedures
    - In-flight monitoring
    - Diversion considerations
    - Non-normal and contingency procedures
- Aeroplane performance data
- EDTO operations manual.

3.9.3 EDTO flight operations practical training

3.9.3.1 The EDTO academic training considerations discussed in Section 3.9.2 provide a basic EDTO training foundation which should be supplemented by practical training as appropriate to the particular roles and responsibilities of flight operations personnel involved in the EDTO operation. For flight dispatch and operations control personnel, this should include training and practical exercises in the specific tools and methods used to support the operation (e.g. EDTO flight planning system). The demonstration of operational procedures related to flight preparation and adherence to any task-related checklists should also be included in the practical training.

3.9.3.2 For flight crews, practical EDTO training typically consists of a line-oriented flight training (LOFT) exercise conducted in a flight simulator device to demonstrate both normal and non-normal EDTO procedures. A typical EDTO LOFT scenario may include the elements listed below and is normally two to four hours in duration. Other en-route considerations specific to the particular operational area such as long-range navigation and communication procedures should be addressed in addition to the EDTO specific training elements.

- Preflight briefing
- EDTO flight release
- Cockpit preparation

- En-route (normal)
  - Entering EDTO sector
  - En-route monitoring procedures
  - FMS procedures (as applicable)
  - Navigation and communication
- En-route (non-normal)
  - Contingency procedures
  - Selected non-normal conditions and checklists
  - Diversion decision-making
  - FMS procedures (as applicable)
  - En-route diversion
- Post-flight procedures.

3.9.4 EDTO recurrent training

3.9.4.1 Recurrent training for EDTO flight operations personnel is typically conducted annually; however, the frequency and duration can vary from this general guideline, and specific currency requirements should be defined in each EDTO operator's approved training programme. A condensed or shortened refresher academics course is typically suitable for recurrent training purposes for personnel who have maintained an active role in supporting the EDTO operation, while the initial training course may be more appropriate for personnel who are no longer current as defined by the approved programme.

3.9.4.2 Practical recurrent training should consider student exposure to different potential operational situations as opposed to repeating the same scenarios in each training cycle. A recurrent EDTO LOFT may, for example, introduce different non-normal diversion conditions (engine failure, decompression, cargo fire, etc.) over time to provide a more meaningful training experience. Selection of the demonstrated contingencies may be recorded in each student's training records to ensure that different scenarios are introduced in each recurrent training session.

Chapter 4

EDTO MAINTENANCE AND RELIABILITY REQUIREMENTS

4.1 GENERAL

4.1.1 Background

4.1.1.1 As explained in Section 2.1.5, there are no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines. Although an operator may consider as good practice for its operations with aeroplanes with more than two engines some elements detailed in the following sections of this chapter, these are primarily intended for, and applicable to, EDTO operations of twin-engine aeroplanes only.

4.1.1.2 Notwithstanding that ICAO Standards do not require EDTO certification for aeroplanes with more than two engines, a State may have implemented regulations for EDTO certification of these aeroplanes. In this case:

- Existing ETOPS certifications granted prior to the implementation of the new EDTO Standards in the State regulations remain valid and do not require recertification for EDTO.

- The EDTO certification is reflected by the issuance of an EDTO CMP document. The EDTO CMP document gathers the required configuration standards and maintenance tasks, and as applicable, the flight crew procedures and dispatch standards. For EDTO operations, the aircraft should be configured, maintained and operated according to the EDTO CMP document requirements.

- The EDTO CMP document is approved by the State of Design. It is issued for the initial EDTO certification. It may be revised to reflect the conclusions of the in-service experience review (reliability surveillance performed by the State of Design through the airworthiness directive process). Refer to Section 2.2.5 for further information on continued validity of EDTO certification.

4.1.2 EDTO awareness

All personnel involved in the maintenance programme should be made aware of the special nature of EDTO and have an understanding as to its impact on their responsibility to the maintenance programme. The maintenance programme should contain the standards, guidance and directions necessary to support the proposed EDTO operations.

4.1.3 Assessment

The AWI having jurisdiction over the operator should assess over an appropriate period of time (e.g. three months, or as found appropriate by the national authority) the maintenance programme's suitability to support the proposed EDTO operations before the authorization by specific approval for EDTO can be granted.

4.2 EDTO MAINTENANCE PROGRAMME

4.2.1 General

4.2.1.1 In the context of this manual, the term "EDTO maintenance programme" means the maintenance related elements (maintenance tasks, organization manuals, procedures, etc.) that must be implemented by the operators to support their EDTO operations. In this context, the aircraft maintenance programme for EDTO is one element of the operator's EDTO maintenance programme.

4.2.1.2 The operator's EDTO maintenance programme should contain the standards, guidance and directions necessary to support the intended EDTO operations. All personnel involved with EDTO should be made aware of the special nature of EDTO and have the knowledge, skills and ability to accomplish their specific areas of responsibility to the programme. The EDTO maintenance programme should identify personnel and areas where an EDTO qualification is required (see 4.7 and 4.17).

4.2.2 Elements of the EDTO maintenance programme

4.2.2.1 The typical elements of an operator's EDTO maintenance programme are identified below:

- EDTO maintenance procedures manual (see 4.3)
- EDTO CMP document (see 4.4)
- Aeroplane maintenance programme for EDTO (see 4.5)
- EDTO significant systems (see 4.6)
- EDTO-related maintenance tasks/EDTO qualified staff (see 4.7)
- Parts control programme (see 4.8)
- EDTO service check (see 4.9)
- Reliability programme (see 4.10)
- Propulsion system monitoring (see 4.11)
- Verification programme (see 4.12)
- Dual maintenance limitations (see 4.13)
- Engine condition monitoring programme (see 4.14)
- Oil consumption monitoring programme (see 4.15)
- APU in-flight start monitoring programme (see 4.16)
- Control of the aeroplane's EDTO status: EDTO release statement (see 4.17)
- EDTO training (see 4.18).

4.2.2.2 These elements are further detailed in this chapter. These elements should be set up by operators as part of their demonstration of compliance against the maintenance criteria of applicable EDTO operational regulation.

4.2.2.3 The required elements of the EDTO maintenance programme should be reviewed in conjunction with the applicable aeroplane maintenance programme to ensure that they are adequate to meet the specific EDTO maintenance requirements as defined in the EDTO CMP document (see 2.2.2.3) for the AEC and any applicable instructions for continued airworthiness (ICA) that may affect EDTO requirements.

4.2.2.4 Maintenance personnel and other personnel involved should be made aware of the special nature of EDTO and have the knowledge, skills and ability to accomplish the requirements of the programme. Refer to Sections 4.7 and 4.18 for further guidance on the need for EDTO qualification of relevant personnel.

4.3 EDTO MAINTENANCE PROCEDURES MANUAL (EMPM)

4.3.1 Background

4.3.1.1 The operator should include EDTO information in the relevant part(s) of the basic maintenance procedures manual (MPM) or publish this information as a "stand alone" EDTO maintenance procedures manual (EMPM).

Note.— The EMPM terminology may vary in different operator programmes or State regulations.

4.3.1.2 This EMPM or the EDTO content of the basic MPM defines EDTO maintenance practices supporting these operations as well as responsible persons and/or organizations. The manual should include, either directly or by reference to incorporated documents, the requirements described in Chapter 4.

4.3.2 Purpose

4.3.2.1 The purpose of the EMPM (or EDTO content of the basic MPM) is to provide involved personnel and EDTO authorized persons with a descriptive means aimed at ensuring safe and efficient EDTO operations.

4.3.2.2 Accordingly, all EDTO requirements, including supportive programme procedures, duties and responsibilities, should be identified as being related to EDTO. The EMPM (or the EDTO content of the basic MPM) should be submitted to the AWI for review and acceptance with sufficient lead-time prior to the scheduled commencement of EDTO operations of the particular aeroplane type, model or variant (AEC).

4.3.2.3 The EMPM (or EDTO content of the basic MPM) should typically address the following topics:

a) general information on applicable EDTO rules and the operator's EDTO programme;

b) scope of operator's EDTO authorization (routes, fleet, diversion time, etc.);

c) responsibilities (maintenance control centre, engineering, quality, training, planning and production, etc.);

d) processes (daily review, reporting, dual maintenance limitations, etc.);

e) EDTO maintenance procedures (aircraft release, EDTO service check, oil consumption monitoring, etc.); and

f) EDTO maintenance training.

4.3.3 Revision control

Revisions to this EMPM (or the EDTO content of the basic MPM) should be reviewed and approved as applicable by the AWI for major changes to the programme. However, minor administrative revisions may not require formal review or acceptance by the AWI.

4.4 EDTO CONFIGURATION, MAINTENANCE AND PROCEDURES (CMP) DOCUMENT

4.4.1 General

4.4.1.1 The EDTO CMP document defines the minimum standards for EDTO relative to any system improvements (configuration), maintenance tasks or operational procedures required for the EDTO operational approval. These standards are defined and approved by the State of Design of the aeroplane manufacturer in the frame of the EDTO certification of the aeroplane (see 2.2.2).

4.4.1.2 Operators should comply with the applicable requirements stated in this document for each aeroplane for which an EDTO authorization is requested. Any deviation from these requirements should be approved by the CAA.

4.4.1.3 Operators should have procedures and responsible persons defined in their EMPM to ensure compliance with this document. The EDTO maintenance programme must include all tasks and related intervals as defined in the CMP, and the operational programme must include any procedures required by the CMP and be coordinated with the maintenance organization, where applicable.

4.5 AEROPLANE MAINTENANCE PROGRAMME FOR EDTO

4.5.1 General

4.5.1.1 The aeroplane maintenance programme for EDTO should contain the standards, guidance and directions necessary to support the intended EDTO operations.

4.5.1.2 The aircraft maintenance programme for EDTO should consider:

a) all scheduled tasks applicable to both EDTO and non-EDTO operations, coming typically from the maintenance review board report/maintenance planning document (MRBR/MPD) or certification maintenance requirements (CMR) documents;

b) the additional specific task intervals coming typically from the EDTO CMP document; and

c) unscheduled maintenance affecting EDTO significant systems that must be managed according to the details provided in this chapter.

4.5.2 Applicability of the aircraft maintenance programme for EDTO

4.5.2.1 The aircraft should be maintained in accordance with the aircraft maintenance programme for EDTO as long as it is operated on EDTO flights.

4.5.2.2 It is not mandatory to comply with the aircraft maintenance programme for EDTO while the aircraft is not operated on EDTO. However, compliance with this aircraft maintenance programme for EDTO becomes mandatory as soon as the EDTO operations are resumed, which may entail execution of some tasks before EDTO operations can be resumed in order to restore the EDTO status of the aircraft (see 4.5.3).

4.5.3 Applicability of the aircraft maintenance programme for EDTO during mixed EDTO/non-EDTO operations

4.5.3.1 The applicability of the aircraft maintenance programme for EDTO in case of mixed EDTO/non-EDTO operations should be as follows:

a) any tasks to be performed prior to an EDTO flight (e.g. tasks from the EDTO service check – see 4.9) are not required to be performed before the non-EDTO flights. Nevertheless, some tasks such as oil consumption monitoring may need to be continuously applied to maintain data continuity; and

b) the other EDTO maintenance tasks (i.e. those tasks required only for EDTO or those tasks with an interval specific to EDTO) must be performed, otherwise the aircraft status should be downgraded to non-EDTO.

4.5.3.2 It is not mandatory to perform the above-mentioned EDTO maintenance tasks if the aircraft is not operated on EDTO for an extended period of time. However, should the aircraft be put back into EDTO operations, an assessment of the aircraft maintenance status should be performed as follows:

a) any task to be performed prior to an EDTO flight (e.g. tasks from the EDTO service check – see 4.9) is to be performed prior to each EDTO flight of the aeroplane;

b) any task required only for EDTO should be performed as per the applicable interval; and

c) any task with an interval specific to EDTO must be performed as per the applicable "EDTO" interval to ensure it is not exceeded when EDTO operations are resumed, i.e. should the time since last execution of the concerned task be more than the EDTO interval then the task should be executed before the first EDTO flight.

4.6 EDTO SIGNIFICANT SYSTEMS

4.6.1 Definition

4.6.1.1 The EDTO significant systems are the systems or functions that help preclude and protect a diversion once the aircraft is dispatched on an EDTO flight. The EDTO significant systems are usually defined as systems:

a) whose failure could adversely affect the safety of an EDTO flight (preclusion of a diversion); and

b) whose functioning is important to continued safe flight and landing during an EDTO diversion (protection of the diversion).

4.6.1.2 This list of EDTO significant systems is required mainly to allow the EDTO operator to track and report through the reliability programme the "EDTO relevant" events and to comply with the dual maintenance limitations criteria of the EDTO/ETOPS regulations.

4.6.1.3 Section 2.2.3 defines the process to identify these EDTO significant systems and defines how the operator should manage its EDTO maintenance programme based on these EDTO significant systems. Section 4.6.2 further details the maintenance activities which need EDTO significant systems.

4.6.2 Applicability to EDTO maintenance programme

4.6.2.1 The operator should identify a list of EDTO significant systems for each fleet of a given aircraft type that will be operated on EDTO.

4.6.2.2 This list of EDTO significant systems is primarily defined by engineering judgment considering the systems' safety analyses and/or design requirements. It is normally provided by the aircraft manufacturer as a recommendation, designed to help the EDTO operators establish their own list of EDTO significant systems.

4.6.2.3 An operator may add other equipment or systems that are considered important for EDTO operations (whether it is for safety or for economic reasons). Conversely, an operator may find a given section of the list provided by the manufacturer too conservative; according to its own experience, internal policies or national regulations, this operator may well slightly alleviate the content of the EDTO significant systems list provided by the manufacturer.

4.6.2.4 These EDTO significant systems impact the EDTO maintenance programme in the following areas:

a) maintenance activities for which it is necessary to adopt precautions to avoid multiple human errors. Typically on such systems, the same mechanics should not do maintenance on two channels at the same time, unless a dual verification is performed (see 4.13). These activities typically include:

   1) the EDTO service check – these systems must have positive corrective action or MEL coverage prior to EDTO dispatch;

   2) dual maintenance – the operator should consider dual maintenance activities prior to an EDTO flight;

   3) verification – the operator should have accomplished positive verification (ground verification or flight verification only if necessary) prior to an EDTO flight or MEL relief applied prior to dispatch; and

   4) for those operators who identify EDTO tasks, the associated task cards will be flagged for these systems;

b) activities related to maintaining and monitoring EDTO reliability (aeroplane configuration for EDTO, failure rate trend monitoring):

   1) EDTO parts control – the operator should track parts associated with these EDTO significant systems for reliability and reporting;

   2) EDTO reliability – these systems would impact the event-based reliability programme for EDTO; and

   3) EDTO significant system related occurrences for which the authorities want periodic reporting and analysis (event-oriented reporting of EDTO occurrences in service);

c) activities related to qualification of the EDTO maintenance staff:

   1) EDTO training and qualification – the operator's EDTO training and qualification programme will be impacted by these systems.

4.7 EDTO-RELATED MAINTENANCE TASKS/EDTO QUALIFIED STAFF

4.7.1 An EDTO qualified staff is a person who has received the EDTO training (see 4.18). The operator identifies in its approved EMPM the requirements to be met for being rated as an EDTO qualified staff. The EMPM should also identify the tasks that shall be accomplished by an EDTO qualified staff, in accordance with any applicable regulations.

4.7.2 As explained in Section 2.2.2.5, the maintenance tasks related to EDTO are tasks impacting EDTO significant system(s) tasks or sub-tasks which are not impacting any EDTO significant system(s), e.g. tasks supporting the overall verification process should not be considered as EDTO-related tasks.

4.7.3 The EDTO-related tasks may be scheduled tasks (from the aircraft maintenance programme for EDTO) as well as unscheduled tasks performed using manuals such as aircraft maintenance manuals, fault isolation manuals, and troubleshooting manuals.

4.7.4 The operator should select from the list of EDTO-related tasks those tasks which may be required to be performed by EDTO qualified staff.

4.7.5 The selected EDTO-related tasks should be retained for their EDTO relevance and could include the installation, testing and/or servicing of airframe and propulsion systems identified in the EDTO significant systems list, such as:

a) removal/installation of engine or APU;

b) removal/installation of a component and involving work on fuel/oil/hydraulic/electric/pneumatic systems (VFG, fuel pump, oil system, gearbox, etc.) which could lead, in case of improper execution, to the loss of the concerned engine. This would typically mean tasks related to “Group 1” EDTO significant systems (see 2.2.3.3); and

c) servicing and which may be typically performed during EDTO pre-departure service check (e.g. engine oil, VFG, APU).

4.7.6 The filtering process for identification of these selected EDTO-related tasks should be implemented by the operator.

4.7.7 A typical flow chart for this filtering of the selected EDTO-related tasks is provided in Figure 4.7-1.

4.8 PARTS CONTROL PROGRAMME

4.8.1 General

4.8.1.1 An EDTO operator should have a programme Identified in its EMPM that defines its management process of EDTO parts. This should include the ability to recognize and restrict EDTO based on part capability (90, 120, 180 minutes, etc.). This process should define how the technician identifies EDTO part capability and the coordination within the operator to ensure the flight does not exceed the configuration capability (90, 120, 180 minutes, etc.). This definition should include parts pooling arrangements and any part borrowing capability.

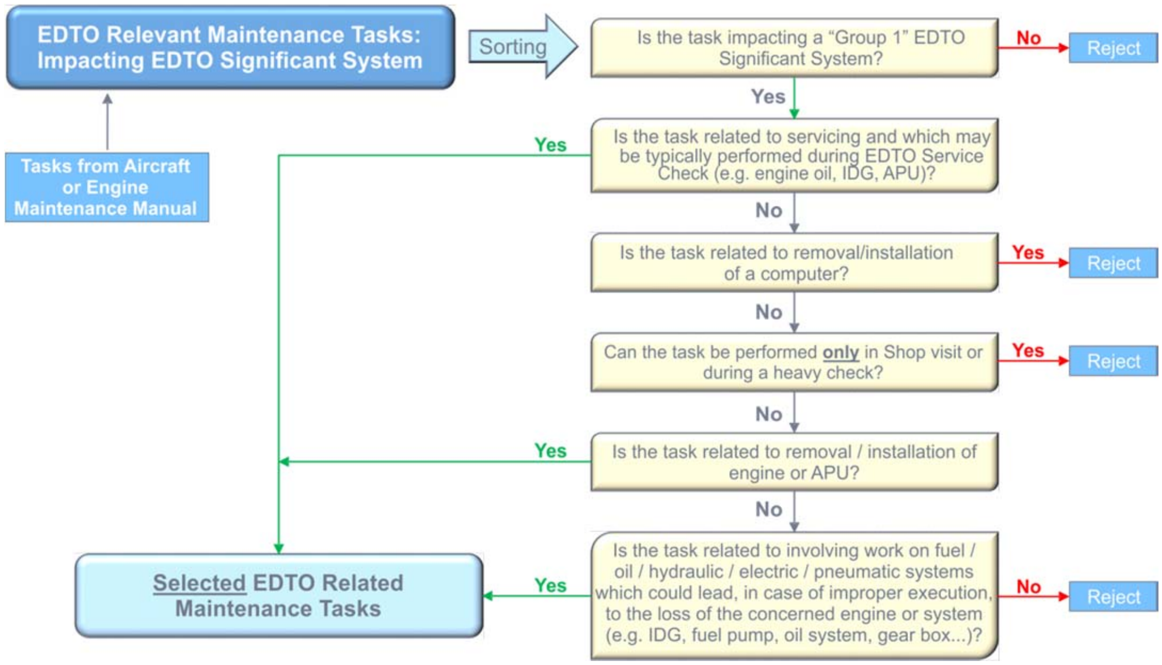

Figure 4.7-1. Filtering of the selected EDTO related tasks

4.8.1.2 EDTO restricted parts are, in most cases, derived from configuration improvements mandated by the CMP. These parts can be applicable to hardware and/or software part numbers (P/Ns), and/or be specific to a group of serialized parts (e.g. an identified batch of parts with a given part number). The engine manufacturer identifies the restricted EDTO parts in its associated illustrated parts catalogue/data (IPC/IPD). The technician must be able to recognize these restricted parts and be familiar with the process to ensure the aeroplane is dispatched in accordance with the limitations of the restricted parts.

4.8.1.3 Operators should have processes in place to ensure compliance with the new CMP requirement until the IPC/IPD has been revised. If the operator allows non-EDTO parts to be installed on the aeroplane, the EMPM should define the processes to restrict the aeroplane and ensure the EDTO-approved parts are installed prior to EDTO dispatch.

4.8.1.4 Agreements where part pooling arrangements have been made should include propulsion system standards, as applicable. Some operators borrow parts on short-term notice and should have similar processes to ensure the correct part is installed to support the EDTO requirement.

4.8.2 Identification of EDTO parts

4.8.2.1 The operator must develop a parts control programme to ensure that proper configuration is maintained for EDTO. These EDTO configuration standards for a given aeroplane model are detailed in the applicable EDTO CMP document. Indeed, per EDTO operational criteria, it is the responsibility of the operator to ensure that the aircraft is configured in compliance with the applicable EDTO CMP document when dispatched on EDTO flights.

4.8.2.2 As explained in Chapter 2, 2.2.2.3, the EDTO CMP document is defined and approved by the State of Design in the frame of the EDTO certification of a given aircraft model. The required EDTO configuration is usually defined through service bulletin or modification numbers in the EDTO CMP document.

4.8.2.3 Therefore, an EDTO parts list should be developed in order to identify and to manage the EDTO components. This EDTO parts list, which may be provided by the aircraft manufacturer, should reflect the configuration requirements of the EDTO CMP document. For each CMP configuration item, the EDTO parts list should identify the part numbers (P/Ns) that are "not approved for EDTO" and those that are "approved (or mandatory) for EDTO". The pre-modification P/Ns are those with EDTO restriction (e.g. "not approved for EDTO" P/Ns), while the post-modification P/Ns are the P/Ns "approved (or mandatory) for EDTO".

4.8.2.4 The EDTO status of a given part may be identified on its tag, and this information may also be included in the illustrated parts catalogue. In case of doubt about EDTO status of a specific part, the EDTO CMP document should be used as the reference for assessment of the required EDTO configuration.

4.8.2.5 The EMPM should detail the process in place to ensure the proper identification of the EDTO status of the parts. This process should continuously ensure that any new EDTO configuration restrictions (e.g. coming from revised CMP standards) are properly identified.

4.8.3 EDTO parts provisioning

The EDTO requirements have an indirect impact on parts provisioning policy. These requirements may be split in two areas, standard and quantity of parts to be provisioned:

1) **Standard of parts to be provisioned**: This aspect is discussed in 4.8.2.

2) **Quantity of parts to be provisioned**: There is no required minimum quantity of spare parts in the EDTO rules; however, the more restrictive MMEL may have an impact on the operator's policy for spare provisioning. The assessment of spare requirement will have to take into account the different dispatch allowance between EDTO and non-EDTO, as well as the level of EDTO (e.g. 120 or 180 minutes) and area of operations. Spare requirement may be different if the return leg to main base can be done along a non-EDTO route (or with a lower diversion time). Dispatch reliability may also be used as a criterion for the assessment of spare parts requirements, as for non-EDTO operations.

4.9 EDTO SERVICE CHECK

4.9.1 General

4.9.1.1 EDTO operators should perform an EDTO service check prior to each EDTO flight in order to confirm adequate operation of significant systems prior to EDTO dispatch.

4.9.1.2 The systems to be checked are derived from the operator list of EDTO significant systems; indeed, the list of relevant systems depends on the design and technology of the aircraft. Furthermore, the EDTO CMP document may also not contain the service check tasks, as these tasks may not be identical for all operators and may depend on the route structure (network) and maintenance organization and processes in place (e.g. cockpit-based checks at transit).

4.9.1.3 The check is intended to ensure there are no existing EDTO log book items that are applicable to EDTO significant systems remaining prior to EDTO dispatch. The two objectives are to prevent system failures during the next EDTO flight and to correct system failures (before the next EDTO flight) that are not allowed by the EDTO MMEL.

4.9.2 Typical content of the EDTO service check

4.9.2.1 At a minimum, the EDTO service check should contain:

a) verification that all EDTO significant systems defects have been resolved or have sufficient MEL coverage;

b) review of the aeroplane technical log for EDTO significant system items and servicing entries;

c) performance of an interior and exterior inspection. The exterior inspection is intended to be a general visual inspection (GVI) from ground level;

d) verification of engine oil level to include the APU if it is required for EDTO; and

e) assessment of the EDTO status of the aeroplane and related EDTO maintenance release (see 4.17).

4.9.2.2 The intent of item a) of 4.9.2.1 (EDTO significant systems), is not to perform a test on each item but to review the technical log and aeroplane messaging system for discrepancies in this area. Maintenance level messages are not typically reviewed or evaluated during this check as those soft faults are designed for planning during higher level maintenance checks.

4.9.2.3 Oil consumption for each propulsion system should be verified as acceptable prior to EDTO dispatch and that it meets the mission requirements of the EDTO flight. For operations where the APU must be running for the entire flight (e.g. MEL with generator inoperative), the APU oil consumption rate should support the operation. Some aeroplanes have only three generator sources and are at the minimum requirement for EDTO at dispatch. This requires the APU to be running during the EDTO portion of the flight or in some cases allow the APU to be available during EDTO. The CMP defines the specific operational requirements.

4.9.2.4 The EMPM should identify the EDTO qualification requirements for completing the EDTO service check. These qualifications are defined in the training section of the EMPM and should define the areas of the check which require EDTO qualification. The EMPM should also define how the check is signed for and how the flight crew determine if the check has been completed. The EDTO service check is required by regulation to be completed only prior to an EDTO flight, so the EMPM should define how the non-EDTO flights are to be managed. If the EDTO service check is not completed on these flights, the oil consumption and engine condition monitoring (ECM) data collection should continue. This check is not typically found in the scheduled maintenance programmes (e.g. MRBR/MPD) as these are driven by the structured MSG-3 analysis. This check, however, does need to be managed through the scheduled maintenance process of tracking and reporting.

4.9.3 EDTO service check and line check policy

4.9.3.1 The approach of single EDTO pre-departure service checks may not be compatible with the flight programme (e.g. the mission could be a sequence of EDTO/non-EDTO legs).

4.9.3.2 The regulation allows the introduction of the EDTO service check items in the existing line checks but distinct identification for the EDTO tasks should be marked on the service check task card. The qualification required for signature should also be indicated to ensure the person accomplishing the task understands its limitations.

4.9.3.3 In this case, the single EDTO pre-departure service check is replaced by an EDTO service check policy as illustrated in Figure 4.9-1.

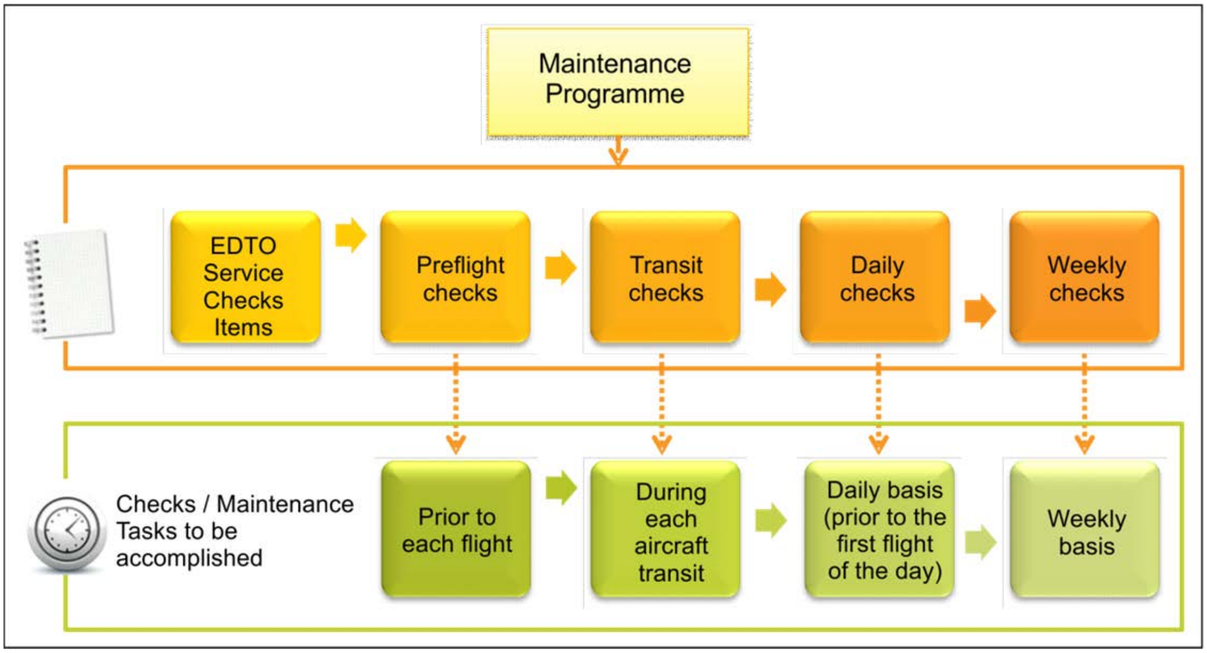

Figure 4.9-1. EDTO service check policy

4.9.4 Execution of EDTO service check

4.9.4.1 The EDTO service check should be accomplished or verified by EDTO qualified staff (see 4.7).

4.9.4.2 Depending on the applicable national rule or policy, and depending also on the content of the EDTO service check, it may be accepted that the EDTO service checks/tasks are done by flight crew members, as long as they meet the qualification requirements.

4.9.4.3 This could typically be the case when the related EDTO service check calls for a cockpit check of relevant parameters. However, in this context, the flight crew should not be allowed nor required to perform a maintenance action (rectification).

4.9.5 Physical check versus cockpit check

The accuracy of indicating systems and reliability of aircraft systems and engines, combined with the low level of oil consumption of today's engines, make it possible to increase the number of legs between physical checks of the system or component. In this case, flight deck verification is acceptable. In addition, verification from the flight deck minimizes the risk of human error during physical check.

4.10 RELIABLITY PROGRAMME

4.10.1 Purpose

4.10.1.1 The EDTO operator should create an event-based EDTO reliability programme based on its EDTO significant systems list. This programme would enhance any existing reliability programme be it a statistical-based programme or a continuing analysis and surveillance (CASS) programme. The programme should be designed with the objective to allow early identification and prevention of EDTO-related significant events and ensure that EDTO reliability is maintained.

4.10.1.2 The programme should be event-oriented and incorporate reporting procedures for EDTO significant events and trends detrimental to EDTO flights. This information should be readily available for use by the operator and the AWI to help determine that the reliability level is adequate, and to assess the operator's competence and capability to safely perform EDTO. An EDTO reporting programme should be established which ensures that the AWI is notified, typically monthly, on the previous month's activities or more often if adverse trends reportable through this programme are identified.

4.10.1.3 Air operators who contract any part of their maintenance control system and/or reliability programmes that support their EDTO authorization to any other organization remain responsible for ensuring that all elements of this programme are addressed and continue to meet the applicable requirements. The EMPM should identify the processes and procedures of this agreement and identify the air operator's accountable staff.

4.10.2 Impact on EDTO diversion time capability

4.10.2.1 Air operator procedures to manage the EDTO diversion time capability of a given aeroplane or fleet of aeroplanes should be established and implemented. These procedures should provide the maintenance manager with the authority to limit, as may be deemed necessary, this EDTO diversion time capability of the applicable aeroplane or to reinstate it once adequate corrective actions have been identified and implemented.

4.10.2.2 A reduction of this EDTO diversion time capability may be needed if:

a) an unresolved significant event is identified on any flight, including non-EDTO flights, of the operator's EDTO approved aeroplane type affected; or

b) an adverse trend is identified through the reliability programme; or

c) the approved EDTO capability of the aeroplane, granted by the State of Design, has been reduced.

4.10.3 APU in-flight start monitoring

4.10.3.1 The applicable national EDTO operational requirements may require the EDTO operator to perform periodic high altitude and cold soak APU in-flight starts, typically when the APU is a back-up source for electrical or pneumatic power.

Note.— This requirement typically applies to twin-engine aeroplanes only as aeroplanes with more than two engines usually have more redundant power sources provided by the higher number of installed engines.

4.10.3.2 The capability of the APU to perform cold soak starts throughout the flight envelope is usually demonstrated by the manufacturer during the EDTO/ETOPS certification of the aeroplane.

4.10.3.3 Therefore, the purpose of the APU in-flight start monitoring programme by the operator is primarily to demonstrate and/or confirm the continued ability of the APU to perform high altitude cold soak starts and to ensure that the maintenance programme provides adequate support for that intent.

4.10.3.4 The APU in-flight start monitoring programme should demonstrate that a 95 per cent success rate is achieved for high altitude cold soak starts.

Note.— In this context, a successful start is usually defined as being one where the APU starts within three attempts. The maximum number of start attempts should be within the limits specified in the applicable aeroplane or APU documentation.

4.10.3.5 The APU in-flight starts should be performed within the concerned EDTO fleet of the operator, as well as the non-EDTO fleet, if any, if these APUs are configured and maintained in accordance with the EDTO CMP requirements.

Note.— Refer to Section 4.16 for additional guidance on an APU in-flight start monitoring programme.

4.10.4 Propulsion system reliability monitoring

4.10.4.1 Where reliability data indicate that the applicable in-flight shutdown (IFSD) rate of the propulsion system is no longer being met, the AWI should be notified of the corrective measures taken. If the reliability data show a continual degradation below the applicable target reliability level, a substantiated plan for resolution should be submitted and consideration for a reduction in EDTO capability may be warranted, as explained in Section 4.11.

4.10.4.2 The IFSD rate of the operator's fleet may be impacted significantly if the fleet is small in count (typically fewer than 15 aircraft). In this case, the IFSD rate computation will mainly be used as a trending mechanism. Exceedance of the target rate should therefore not be used as the only reason to suspend EDTO operation. Indeed, when the number of engine hours over a year is not sufficient to be statistically representative, the reliability of EDTO operation should be reviewed on an individual event basis. An event-orientated analysis of each in-service event should therefore be performed. This analysis shall identify the root cause of the event and define the related corrective actions (if any).

4.10.5 Tracking and reporting of EDTO relevant events

4.10.5.1 The following events should be included in the reporting programme:

a) in-flight shutdowns or flameouts;

b) diversion or turn-back;

c) uncommanded power changes or surges;

d) inability to control the engine or obtain desired power; and

e) significant events or adverse trends with EDTO significant systems.

4.10.5.2 The report should also identify the following:

a) aeroplane identification;

b) engine identification (make and serial number);

c) total time, cycles and time since last shop visit;

d) for systems, time since overhaul or last inspection of the defective unit;

e) phase of flight;

f) corrective action; and

g) resulting action by the flight crew (divert, return, continue, etc.).

4.10.6 Assessment of EDTO reliability indicators

4.10.6.1 Where statistical assessment alone may not be applicable (i.e. when the fleet size is small), the air operator's performance should be reviewed on a case-by-case basis.

4.10.6.2 The review may include such items as actual data populating the air operator's reliability programme and this being compared, where possible, to worldwide fleet data of the concerned AEC and related EDTO maintenance significant systems, as well as air operator events, including IFSDs and loss of thrust, with the results of investigation into the cause(s) of the events.

4.10.6.3 This recommendation to focus on the root-cause of the events and the corrective action(s) taken, rather than on the reliability figures alone, may actually apply to any fleet.

4.10.6.4 Indeed, regardless of the reliability level, it is possible that a particular event may also warrant corrective action implementation even though the applicable reliability indicators are not being exceeded. It also implies that any EDTO relevant event in the operator's fleet (i.e. EDTO and non-EDTO) should be reviewed.

4.10.6.5 Analysis of propulsion reliability is only one part of the whole assessment that should be performed in the frame of decision process to grant, maintain or reduce the EDTO authorization.

4.11 PROPULSION SYSTEM MONITORING

4.11.1 Background

The engine reliability should be tracked at two levels:

1) by the manufacturers and the State of Design as part of the continued airworthiness surveillance of a given AEC (worldwide fleet). The goal of this tracking is to ensure that the EDTO capability of a given AEC is demonstrated and maintained (see 1.5);

2) by the EDTO operator and its CAA for the fleet (of this operator) of a given AEC. The goal of this tracking is to provide an indicator, but not the only indicator, of the reliability of the concerned operators' EDTO operations (see 1.6).

4.11.2 In-flight shutdown (IFSD) rate

4.11.2.1 The IFSD rate is a statistical indicator commonly used to assess the reliability of the concerned engine model versus the target rate set by applicable regulations.

4.11.2.2 The IFSD rate is a reliability figure calculated by dividing the chargeable number of in-flight shutdowns by the total engine operating hours accrued during the same period. The IFSD rate is usually computed over a 12-month rolling average basis for the concerned AEC; it is, therefore, the count of IFSD(s) over the total engine hours cumulated during the last 12 months.

4.11.2.3 The IFSD rate may be computed for the worldwide fleet of the concerned AEC; this is the rate monitored by the State of Design to assess the EDTO capability of a given AEC.

4.11.2.4 The IFSD rate should also be computed by the operator for its fleet of concerned AEC; this is the rate that may be considered by the CAA as part of the continued reliability assessment of the concerned operators' EDTO operations.

4.11.2.5 The IFSD alert levels should be provided in the applicable national regulation (e.g. AMC 20-6 for EASA countries or FAA 14 CFR 121.374(i)).

4.11.2.6 The applicable IFSD alert levels are typically defined for a given maximum diversion time (e.g. 120, 180 minutes and beyond 180 minutes).

4.11.2.7 These IFSD levels for the operator may also consider the size of the fleet as this may have a great impact on the operator's IFSD rate; indeed, due to a smaller number of cumulated hours during 12 months, the impact of one engine failure on an operator's IFSD rate may be significantly higher than on the worldwide fleet rate.

4.11.3 IFSD definition

4.11.3.1 The definition of an IFSD is usually provided in the applicable national regulation. The commonly retained definition of an IFSD for EDTO is when an engine ceases to function (when the aeroplane is airborne) and is shutdown, whether self-induced, flight-crew initiated or caused by an external influence.

4.11.3.2 Typical examples of engine in-flight shutdown causes retained for the computation of the IFSD rate are: flameout, internal failure, flight-crew initiated shutdown, foreign object ingestion, icing, inability to obtain or control desired thrust or power, and cycling of the start control, however briefly, even if the engine operates normally for the remainder of the flight.

4.11.3.3 It should also be noted that the following events are normally not counted as IFSD:

a) engine failures before take-off decision speed or after touchdown;

b) airborne cessation of the functioning of an engine when immediately followed by an automatic engine relight; and

c) engine does not achieve desired thrust or power but is not shut down.

4.11.3.4 In most national EDTO regulations, these events are not counted as IFSD but should still be reported to the competent authority in the frame of continued airworthiness for EDTO.

4.11.4 IFSD rate monitoring

4.11.4.1 The assessment of propulsion systems' reliability for the EDTO fleet should be made available to the AWI (with supporting data) in accordance with the approved EDTO maintenance control system.

4.11.4.2 Where the combined EDTO fleet is part of a larger fleet of the same AEC, data from the air operator's total fleet may be acceptable. The reporting requirements of Section 4.10 should still be observed for the EDTO fleet.

4.11.4.3 Any adverse trend requires an immediate evaluation to be done. The CAA should be advised of the result of the evaluation. The evaluation may result in corrective action and/or operational restrictions being applied.

4.11.4.4 The operator should investigate any indication of high IFSD rate.

4.11.4.5 However, as explained in Section 4.10.3, in the case of a smaller fleet, the high IFSD rate may be due to the limited number of engine operating hours used for the rate calculation. This can cause an IFSD rate being well above the target rate because of a single event. The underlying causes for such a jump in the rate should be considered by the AWI in assessing the need for corrective actions.

4.11.4.6 Conversely, implementation of corrective actions may be warranted further to a series of IFSDs occurring in a larger fleet, typically in case of common cause events, even if these events have not led to an exceedance of the applicable IFSD alert level.

4.12 VERIFICATION PROGRAMME

4.12.1 General

4.12.1.1 The operator should have a verification programme that ensures positive corrective action on all-engine in-flight shut down occurrences and EDTO significant system failures, or that MEL relief is applied prior to an EDTO flight. The approved ground verification tasks should be defined in the EMPM and should promote positive ground verification prior to EDTO dispatch. These may include, but are not limited to, the aircraft maintenance manual, fault isolation manual, troubleshooting manual, scheduled maintenance task, MPD, operator approved procedures or any other approved instruction manual.

4.12.1.2 If an in-flight verification programme is approved, it should be defined in the EMPM. It is acceptable to use EDTO or non-EDTO flights for this verification process. The verification should be completed prior to reaching the EEP.

4.12.1.3 The operator should establish means to assure proper accomplishment of these verifications actions. A clear description of who should initiate verification actions and the section or group responsible for the determination of what action is necessary should be identified in the programme.

4.12.2 Purpose and content

4.12.2.1 The purpose of this verification programme is to ensure the effectiveness of maintenance actions taken on EDTO significant systems.

4.12.2.2 Troubleshooting procedures and maintenance tasks published by the aircraft or engine manufacturers are basically considered as adequate verification action. Nevertheless, the operator may be required to develop further verification action based on its own in-service experience.

4.12.2.3 The EMPM should include the list of EDTO significant systems or conditions (dual maintenance action, heavy maintenance, etc.), if any, requiring specific verification actions, considering the operator's own in-service experience and any applicable national regulations or guidance.

4.12.3 Typical verification actions

These specific verification actions may typically be required in case of:

- simultaneous maintenance action/tasks on parallel EDTO significant systems. Typical additional verification action in this case would be an in-flight verification of relevant parameters prior to entry into the EDTO sector (e.g. during the first 60 minutes of the flight) or during a non-EDTO flight.

  Another acceptable verification action could be that the tasks are performed by different technicians on each EDTO significant system or performed by one technician directly supervised during the task application by another EDTO qualified technician. In both cases, the required ground verification test (and/or in-flight verification test, if needed) is performed by a qualified individual.

- maintenance action on items that cannot be fully verified on ground. An example of a condition that would require an in-flight verification is the replacement of an APU component that could affect the APU's ability to start at the EDTO cruise altitude after cold soak.

- review of the relevant operator's EDTO maintenance experience indicating that the ground verification actions published in the aircraft maintenance manual or troubleshooting manual may not be fully effective for EDTO. Note that unless otherwise demonstrated by this review, it should be considered that the troubleshooting procedures and maintenance tasks published by the manufacturers are verification actions fully adequate and valid for EDTO.

4.12.4 Verification actions after complex maintenance check

4.12.4.1 Following multiple maintenance actions/tasks performed during a heavy check, it may be considered that the first flight after such a complex maintenance check cannot be an EDTO flight. In this case, this non-EDTO flight (which may be a commercial flight) may therefore be considered as the relevant verification action.

4.12.4.2 Nevertheless, it should be noted that the proper accomplishment of appropriate verification actions after the heavy check aims at ensuring that the aircraft is airworthy. Therefore, it is also acceptable to consider that an in-flight verification for EDTO may not be needed. The operator should make this decision on the need for a dedicated in-flight verification for EDTO and accordingly seek authorization from its CAA.

4.12.4.3 Concerning the particular case of single-engine replacement, it is not required to perform a verification flight after such maintenance action. The instructions and verification actions provided in the aircraft or engine maintenance manuals should therefore apply. Nevertheless, as the engine replacement involves the deactivation/reactivation of several EDTO significant systems (electrical generators, hydraulic pumps, bleed air system, engine oil system, etc.), an operator may choose to call for an in-flight verification. The concerned parameters to be monitored should obviously include any relevant parameters indicating a proper engine functioning (fuel flow, EGT, etc.) but also be related to proper functioning of the other impacted EDTO significant systems. Depending on applicable policy, such verification may be performed before entering the EDTO sector of an EDTO flight.

4.12.4.4 The operator should include the applicable procedure for such a case in the EMPM, based on its own in-service experience and any applicable national regulations or guidance.

4.13 DUAL MAINTENANCE LIMITATIONS

4.13.1 Background

4.13.1.1 EDTO operators should have an approved programme to ensure maintenance performed on the same element of identical but separate EDTO significant systems during the same routine or non-routine maintenance visit prevents duplication of a human error. Dual maintenance is commonly defined as any maintenance performed that could induce the same fault into redundant components of the same EDTO significant system or function.

4.13.1.2 The purpose is to minimize the risk of errors while performing the maintenance task on these parallel or identical EDTO significant systems. Indeed, such maintenance error(s) could lead to dual system failure which could potentially cause aircraft diversions in degraded configurations.

4.13.2 Applicability and general recommendations

4.13.2.1 The “same” EDTO significant system is typically one that is in the same ATA reference and would reduce the redundancy level designed into the twin-engine aeroplane to support EDTO. An example would be maintenance on the left-engine-driven electrical generator and the right-engine-driven electrical generator.

4.13.2.2 Simultaneous maintenance on different engine driven components on both engines should also be considered as dual maintenance due to the possibility of affecting both propulsion system oil or fuel supplies. An example of this would be maintenance performed on the number one engine-driven electrical generator and the number two engine hydraulic pump. Each are in separate ATA references but a similar human error could cause a dual engine failure.

4.13.2.3 In this context, the list of EDTO significant systems may identify the systems that are identical (see 4.13.2.9) and those that are similar (see 4.13.2.10). The “similar” category may be further split in two sub-categories “substantially similar” and “redundant”, as indicated in Section 4.13.2.10.

4.13.2.4 Any maintenance actions on EDTO significant systems which are not falling in these categories are therefore not subject to dual maintenance limitations.

4.13.2.5 Some (but not necessarily all) of the maintenance actions on EDTO significant systems which are in these categories may therefore be subject to dual maintenance limitations.

4.13.2.6 The determination can be made by evaluating common mechanical tasks that historically have created this situation of dual system fault or loss, or through an evaluation of the maintenance tasks and aeroplane level of consequences of improper maintenance. Consideration should be given to the difficulty of the task, accessibility to the component, and testing procedures.

4.13.2.7 The selected tasks are commonly those that are mechanical in nature and are managing fluid or pneumatics (fuel, oil, air, etc.) that may be used for control purposes. In case of improper maintenance, these components may develop some leakage after a period of time in the next flight. Some examples are engine-driven component installation, fuel couplings, pneumatic couplings and control pressure lines to actuators or valves.

4.13.2.8 Tasks that should not be selected are typically maintenance tasks on electronic systems or software which are using internal monitoring and fault detection. The risk of inducing twice the same non-detected human error is minimal due to the design of the system and software, especially those systems which include an operational and/or functional verification check following maintenance action.

4.13.2.9 ***Identical EDTO significant systems***

Two or more systems may be identified as “identical” EDTO significant systems when they are the same (fit, form and function). Examples of “identical” EDTO significant systems are the left engine-driven electrical generator and the right engine-driven electrical generator.

4.13.2.10 ***Similar EDTO significant systems***

Two or more systems may be identified as “similar” when they are either:

a) “substantially similar” EDTO significant systems: These are engine-driven components mounted on both engines with similar attach procedures. Examples of “substantially similar” EDTO significant systems are the electrical generator mounted on engine one and the engine-driven hydraulic pump mounted on engine two. Improper installation of these components could result in oil loss on both engines; and

b) "redundant" EDTO significant systems: These are systems providing the same redundant function. Examples of "redundant" EDTO significant systems are the engine-driven electrical generator and the APU-driven electrical generator. Improper maintenance could lead to multiple loss of EDTO significant systems and/or loss of redundancy in the related EDTO significant function (e.g. dual loss of electrical power sources). Even though the tasks may not be exactly the same, the potential impact of a maintenance error on the level of redundancy should be considered to retain (or not) the related tasks as dual maintenance action. This could typically be the case of tasks involving complex removal/installation procedures where possibilities exist to induce a fault that could lead to the same consequence (i.e. loss of concerned system or function) in both systems.

4.13.3 Compliance

4.13.3.1 An acceptable programme of dual maintenance limitations to prevent loss of EDTO significant system redundancy should be defined in the operator's EMPM. This programme should take into account the aircraft design architecture and systems reliability, the operator's experience and any applicable national regulations or guidance.

4.13.3.2 There are different ways to comply with this dual maintenance limitation requirement. It may include (but is not limited to) the following processes:

a) the execution of tasks performed on identical or similar EDTO significant systems is staggered;

b) the task is performed by separate EDTO-qualified technicians;

c) the maintenance action on each of the elements in the EDTO significant system is performed by the same technician under the direct supervision of a second EDTO qualified individual; and

d) the operator verifies the corrective action to those EDTO significant systems as per applicable verification actions.

4.13.3.3 The servicing of fluids and gases is not considered maintenance; however, this should be conducted properly as defined in the manufacturer procedures manual. One technician serving two separate but similar systems is not considered dual maintenance, but the servicing instructions should be followed to ensure EDTO reliability standards are maintained. Operators should emphasize this in their EDTO training programme.

4.14 ENGINE CONDITION MONITORING PROGRAMME

4.14.1 The EDTO operator should implement an engine condition monitoring programme to detect deterioration at an early stage to allow for corrective action before safe operation is affected, and to ensure internal limit margins (e.g. rotor speeds, exhaust gas temperatures) are maintained to support single-engine diversion scenarios. Engine margins preserved through this programme should also account for the effects of additional engine loading demands (e.g. anti-icing, electrical) which may be required during the single-engine flight phase associated with the diversion.

4.14.2 This programme should describe the parameters to be monitored, the method of data collection, and the corrective action process. The programme should reflect the type certificate holder's instructions and the industry practice.

4.14.3 At a minimum, the programme should record these parameters consistently during a benign part of flight, typically at cruise, and record them electronically or manually. These parameters can be defined by the engine manufacturers but could typically include N1, N2, N3, FF, EGT, oil pressure and oil temperature.

4.14.4 Monitoring should be on a continual basis. The information should be collected and trended in a timeline to ensure these parameters are maintained in an acceptable interval. If an electronic reporting and transmitting system is being used, a back-up method should be created to take the place of any automated system that is failed for greater than this interval.

4.14.5 Operators may choose to use engine manufacturer support for this programme. These programmes offered by the manufacturer provide even further enhanced information and protection and are acceptable to meet this requirement. This information should be sent to the operator in a timely manner (interval to be agreed by the authority) and include procedures to ensure that the information is continuous regardless of day or time. Most engine manufacturer data exceed the minimum requirement for this programme and would enhance the operator internal procedures.

4.15 OIL CONSUMPTION MONITORING PROGRAMME

4.15.1 Purpose

The oil consumption monitoring programme is required to allow operators to detect unexpected oil consumption that could be the result of an oil leak or unforeseen engine wear which can impact the EDTO dispatch capability of the aircraft.

4.15.2 Content

4.15.2.1 Regulations do not specify what the maximum oil consumption rate should be for EDTO (i.e. it can be the same as for non-EDTO operations) and what procedure should be applied to compute the consumption rate and detect unusual oil uplift. The oil consumption programme should reflect the type certificate holder’s recommendations and be sensitive to oil consumption trends as well as unusual oil uplifts.

4.15.2.2 The dispatch procedures for EDTO segments are to take into account peak consumption and current running average consumption, including consumption on the immediately preceding segments. If oil analysis is meaningful to this make and model, it should be included in the programme. If the APU is required for EDTO operation, it should be included in the oil consumption programme.

4.15.2.3 This oil consumption monitoring programme for EDTO should define a baseline consumption rate (normal usage) and detect oil consumption based on the previous flight results. This oil consumption or loss must not exceed the manufacturer’s maximum allowable usage rate and is defined in the aircraft maintenance manual.

4.15.2.4 An evaluation must be made prior to the next EDTO flight to ensure the consumption supports the mission requirements. The programme should ensure there were no sudden increases in consumption/loss and, if there were, to initiate proper corrective action.

4.16 APU IN-FLIGHT START MONITORING PROGRAMME

4.16.1 Purpose

4.16.1.1 The purpose of the APU in-flight start monitoring programme is to demonstrate and/or confirm that the APU is able to start at altitude while in flight. This in-flight verification is necessary as the capability of the APU to start at altitude can usually not be demonstrated while the aircraft is on ground.

4.16.1.2 The requirement for APU in-flight start monitoring in the frame of EDTO is usually an operational requirement, i.e. it should be required by the applicable national EDTO operational requirements.

4.16.1.3 The EDTO CMP document contains the configuration and maintenance items necessary to meet the reliability objectives for the APU (run reliability and in-flight start reliability), as defined by the certification requirements. As the continued monitoring of the APU in-flight start capability is an operational requirement, it is usually not reflected in the EDTO CMP document or other aircraft/engine maintenance document (e.g. MRBR or MPD). It allows the operator to adapt, as necessary, its programme for APU in-flight start monitoring to reflect its own utilization of the APU.

4.16.1.4 Since the introduction of the initial ETOPS rules, it is usually a requirement for certification that the aircraft manufacturers demonstrate the in-flight start reliability of the APU when the following two conditions are met:

a) the in-flight start of the APU and use of the APU electrical and/or bleed power source(s) is required in case of in-flight failure of another power source(s) within the EDTO sector; and

b) the continued operation of the APU is not required in the EDTO sector when the aircraft is dispatched in fully operational electrical or bleed configuration (no MEL/MMEL).

4.16.1.5 This in-flight start capability demonstrated by the manufacturers in the frame of the certification activities should be maintained and monitored by the EDTO operators. This is why the operator should develop a programme to monitor the APU cold soak in-flight start and run reliability. Furthermore, tracking and reporting of APU run reliability (including failed in-flight starts) should also be implemented when the APU is classified as an EDTO significant system.

4.16.2 Content

4.16.2.1 The interval between the APU in-flight start tests is usually not prescribed by the regulations. It may be expected to perform these initial in-flight starts on a routine basis typically for the first 6 to 12 months of EDTO operations. The CAA may still ask the operator to perform high-altitude/cold soak start of the APU on a regular basis even after the first months of operations. The applicable national regulations or guidance should mention that the operator may adjust the sampling intervals according to system performance and fleet maturity. In particular, experience has shown that oversampling has the potential to actually degrade the APU in-flight start capability, therefore care should be taken in establishing appropriate sampling intervals.

4.16.2.2 In other words, it is expected that the initial programme may be alleviated and the interval increased, further to a review of relevant maintenance records performed by the CAA when satisfactory in-service experience has been accumulated. Note that the interval should also take into account the normal utilization of the APU (e.g. on ground). An operator having a low utilization of the APU may have to check it more frequently.

4.16.2.3 The typical interval to initially check the APU is once per month per aircraft. As noted above, this interval may be increased, typically to once every three months per aircraft. Some highly experienced EDTO operators have increased this interval up to once or twice per year per aircraft.

4.16.2.4 Therefore, the operator should propose an APU in-flight start/run programme that is acceptable to its CAA, considering its own experience and any applicable national regulations or guidance. The proposed programme should include periodic sampling of each aeroplane's APU in-flight start capabilities, i.e. the operator should ensure that each aeroplane's APU of the operator's EDTO fleet is periodically checked rather than repeatedly sampling the same APUs.

4.16.2.5 The APU in-flight start tests do not need to be performed systematically during EDTO flights. The start attempts should also not be performed systematically at the top of the aeroplanes and APU operating envelope. However, the duration of the cold soak as well as the altitude of the test should be representative of typical EDTO operations. In other words, the objective of the programme should be to collect data points spread between a range of typical cruise duration and altitudes.

4.16.2.6 In addition to the in-flight starts performed on a routine basis, as described in the Section 4.12, it may be recommended to perform a high-altitude cold soak start test after maintenance action(s) that may impact the start capability of the APU (APU change, replacement of electronic control box, fuel control unit, igniters, etc.).

4.16.3 APU in-flight start reliability objective

4.16.3.1 The reliability objective for APU high-altitude relight should be defined in the applicable national regulation. Usually a 95 per cent success rate is expected to be demonstrated.

4.16.3.2 An APU in-flight start attempt should be classified as "successful" when the APU is started within three start attempts.

4.16.3.3 This 95 per cent criterion serves to monitor the APU in-flight start capability once the EDTO operation has begun. In other words, it is not required to demonstrate the 95 per cent success rate prior to starting EDTO. Accordingly, this analysis/evaluation of in-flight start capability should be done only once a significant set of data has been collected for comparison versus the 95 per cent figure. Typically, the number of high-altitude starts required to demonstrate a 95 per cent success rate should include a minimum of 20 attempts.

4.16.3.4 It is the concerned EDTO fleet of the operator that must be monitored. The non-EDTO fleet, if any, may also be included in the programme but only if these APUs are also configured and maintained in accordance with the EDTO CMP requirements.

4.16.4 Procedure

4.16.4.1 The APU in-flight start test is not a maintenance task. The primary role of the maintenance and engineering organization is to actually:

a) launch the request of an APU in-flight start check which will be executed by the flight operations organization (see 3.6.2.4.2); and

b) record the success or failure for appropriate further maintenance action(s).

4.16.4.2 Specific procedures to address the maintenance and engineering roles should include:

a) notification of the APU in-flight start requirement to flight crews through the maintenance release process; and

b) documentation procedures for recording and tracking of success or failure of start attempts as well as reporting to the CAA.

4.17 CONTROL OF THE AEROPLANE'S EDTO STATUS: EDTO RELEASE STATEMENT

4.17.1 Purpose

4.17.1.1 As explained in Chapter 2, the EDTO certification of the aeroplane entails the issuance of an EDTO CMP document which gathers the required configuration, maintenance, procedures and dispatch standards. For EDTO operations, the aircraft should therefore be configured, maintained and operated according to the EDTO CMP document requirements. This means that the operator should implement tools and/or procedures to control any aeroplane discrepancies that may impact the EDTO serviceability of the aeroplane. This may require the implementation of a system to continuously track and manage the EDTO status of the aeroplane.

Note.— As explained in Section 2.1.5, the basic type certification standards and maintenance programme of aeroplanes with more than two engines provides the required level of safety intended for EDTO and remains suitable for EDTO operations. Accordingly, the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines. Therefore, in this case the EDTO status of aeroplanes with more than two engines is directly linked to the status of the relevant TLS(s). In other words, only maintenance or configuration changes (e.g. as identified by the associated configuration, maintenance, and procedures CMP document, if applicable) to the relevant TLS(s) may impact the EDTO status of aeroplanes with more than two engines.

4.17.1.2 In addition, as per Section 4.7.2 of Annex 6, Part I, it is the responsibility of the operator to ensure that the relevant time limitations of the aeroplane engaged in EDTO operations are not exceeded, and for aeroplanes with two turbine engines, that the aeroplane is certified for EDTO and configured for the planned EDTO mission.

4.17.1.3 As the time limitations of a given aeroplane may be impacted by the configuration and/or the maintenance programme of the aeroplane, the operator should implement tools and/or procedures to ensure that the relevant EDTO capability and time limitation(s) of the aeroplane dispatched are compatible with the contemplated EDTO flight, as explained in Section 3.5.4.

4.17.1.4 An EDTO maintenance release statement should therefore be provided to the flight crew to confirm that:

a) the aircraft condition has been checked and confirmed to comply with the applicable EDTO dispatch requirements set forth in the company policies and applicable MEL;

b) the EDTO items of the applicable maintenance line check have been accomplished;

c) the aircraft configuration has been checked and confirmed to comply with the applicable configuration standards set forth in the EDTO CMP document (as applicable); and

d) the capability of relevant TLS(s) has been assessed.

4.17.1.5 The EDTO maintenance procedures manual (or equivalent) should define the content of the EDTO service check and the procedures associated with the EDTO maintenance release (see also 4.3 and 4.9).

4.17.2 EDTO status: Downgrading and restoration

4.17.2.1 If the MEL cannot be complied with for EDTO, or if the aircraft configuration and/or maintenance do not comply with the applicable EDTO CMP Standards, the “non-EDTO” status of the aircraft should be indicated in the aeroplane maintenance logbook.

4.17.2.2 The discrepancy should be recorded and reported to the personnel within flight operations in charge of preparation of the EDTO flights. For example, the deferred discrepancy could be entered in the deferred defects list, and the “non-EDTO” status recorded on the aeroplane technical log or maintenance logbook.

4.17.2.3 To restore the aircraft back to “EDTO” status, all the EDTO discrepancies should be assessed and/or rectified in line with the applicable EDTO CMP configuration and maintenance standards and/or the MEL EDTO requirements. For example, the corresponding deferred defect item should be cleared and the restored “EDTO” status recorded in the aeroplane technical log or maintenance logbook. The up-to-date EDTO status should be recorded and reported to the personnel within flight operations in charge of preparation of the EDTO flights.

4.17.2.4 The changing of the aircraft EDTO status to “EDTO/non-EDTO" should be carried out by the EDTO authorized person responsible for the aircraft and advised to the maintenance control centre (or other control system) prior to aeroplane release for service.

4.17.2.5 The changing of the aircraft EDTO status to “EDTO/non-EDTO” away from main base by the flight crew when an EDTO authorized person is not available should only be permitted on receipt of authorization from the maintenance control centre (or other control system). The EDTO status change should be recorded in the aeroplane technical log or maintenance logbook by the flight crew prior to the aeroplane release for service.

4.17.3 EDTO release statement — twin-engine aeroplanes

4.17.3.1 The EDTO status of the aircraft should be indicated to the flight crew prior to each EDTO flight. For that purpose, an EDTO release statement should be issued and it may be included in the aircraft maintenance logbook.

4.17.3.2 This EDTO status of the aeroplane depends on:

a) the certified EDTO capability of the aeroplane;

b) the configuration of the aeroplane versus the applicable configuration requirements of the EDTO CMP document;

c) the compliance of the aeroplane versus the applicable maintenance requirements of the EDTO CMP document;

d) the capability of relevant TLS(s); and

e) any inoperative system (MEL).

4.17.3.3 An EDTO maintenance release statement should therefore be issued as part of the maintenance release (e.g. certificate of release to service) of the aeroplane. This EDTO maintenance release statement, which is typically included in the aircraft maintenance logbook, should be provided to the operator’s flight operations organization for operations control and flight preparation purposes. It should clearly indicate:

a) whether the concerned aeroplane is EDTO capable (yes or no); and

b) the related maximum diversion time capability.

4.17.3.4 Figures 4.17-1 and 4.17-2 are typical examples of EDTO release statements for two-engine aeroplane EDTO operations up to 180 minutes.

4.17.3.5 As shown in Figure 4.17-1, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO; and

b) its maximum diversion time capability is 120 minutes.

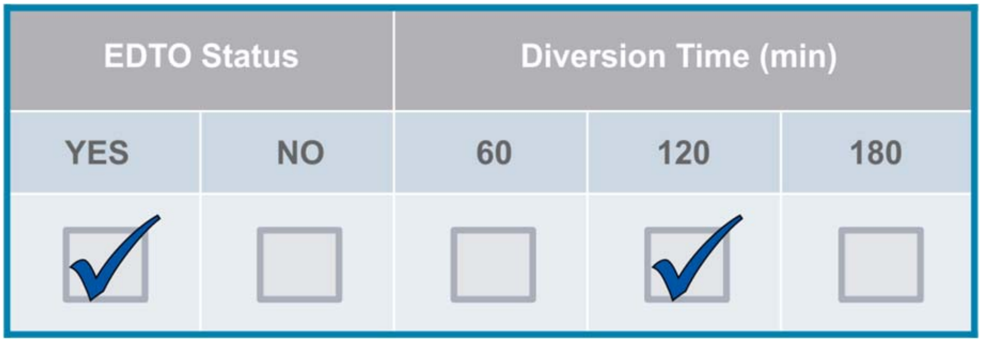

Figure 4.17-1. Example of EDTO release statement (120 minutes)

4.17.3.6 As shown in Figure 4.17-2, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is restricted to non-EDTO operations; and

b) accordingly, its maximum diversion time capability is 60 minutes.

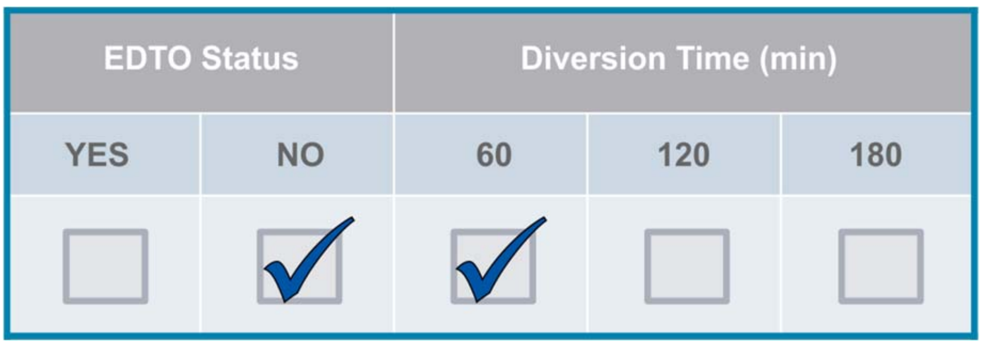

Figure 4.17-2. Example of EDTO release statement (60 minutes)

4.17.3.7 As explained in Section 3.5.4.3, for EDTO operations beyond 180 minutes, the operator has to check that the diversion flight times (plus 15 minutes) along the planned flight track do not exceed the times specified in the AFM (or other relevant aeroplane manufacturer documentation) for the aeroplane's cargo fire suppression system, referred to as the AEO time capability, and for the aeroplane's most TLS time (other than cargo fire suppression), referred to as the OEI time capability.

4.17.3.8 Therefore, a dedicated process for the check and tracking of the time capability of the relevant TLS(s), if any, should be implemented in order to ensure that this information is adequately transferred to the flight operations organization (dispatchers and flight crews).

4.17.3.9 It may be done by including in the EDTO release statement the necessary check boxes for each of the possible values of time capability of the relevant TLS(s). The corresponding values should be updated as part of the aeroplane's maintenance release anytime there is a situation impacting the time capability of the concerned TLS(s), e.g. in case of:

a) the system being inoperative;

b) the system being replaced by another with a lesser/greater time capability; and

c) maintenance action impacting the time capability of the system.

4.17.3.10 Figure 4.17-3 is a typical example of an EDTO release statement for EDTO operations beyond 180 minutes. In this example, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO beyond 180 minutes;

b) its maximum OEI time capability is 340 minutes; and

c) its maximum AEO time capability is 250 minutes.

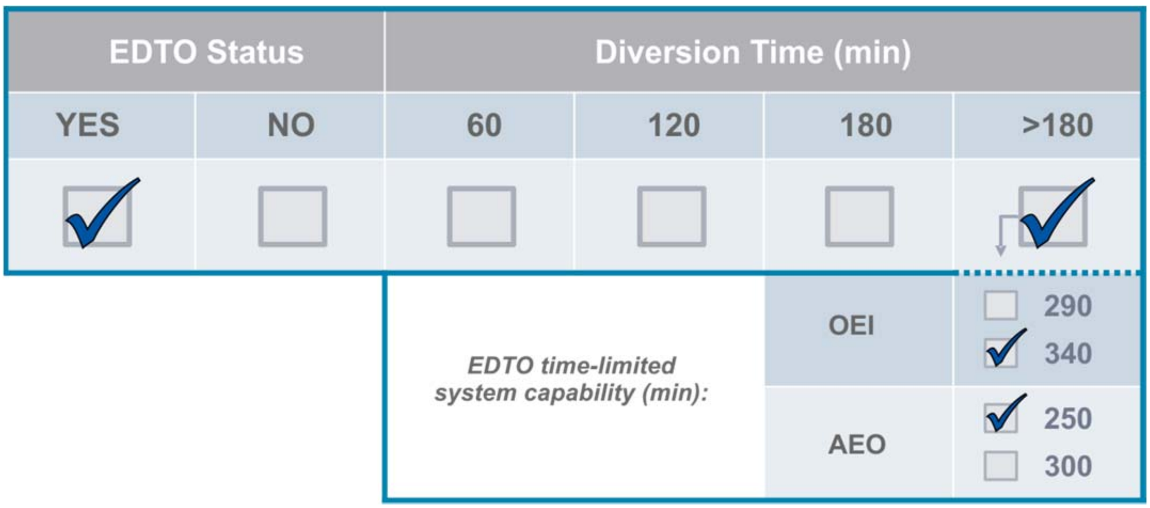

Figure 4.17-3. Example of EDTO release statement (EDTO beyond 180 minutes)

4.17.4 EDTO release statement – aeroplanes with more than two engines

4.17.4.1 As discussed in Section 2.1.5, it has been confirmed that for aeroplanes with more than two engines, both the basic type certification standards and maintenance programme provide the required level of safety for EDTO and are suitable for EDTO operations. Accordingly, the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines. Nevertheless, it has also been concluded that a review of the time limitation of relevant TLSs, if any, is necessary for aeroplanes with more than two engines engaged in EDTO.

4.17.4.2 Therefore, the EDTO status of aeroplanes with more than two engines is linked to the status of the relevant TLS. In other words, only maintenance or configuration changes to the relevant TLS may impact the EDTO status of aeroplanes with more than two engines.

4.17.4.3 The number of items that may impact this EDTO status should be very limited and it may therefore not be necessary to implement a process for EDTO release statement as for twin-engine aeroplanes unless there is an associated CMP document (see 4.17.3). Typically, the impact of an unserviceable TLS (e.g. an inoperative cargo fire suppression bottle) could be handled through the existing deferred defect list, and the related diversion time limitation should be duly taken into consideration when planning the EDTO flight, as for any other MEL items.

4.17.4.4 A system of EDTO release statement may still be implemented to facilitate the management of this EDTO status. Figure 4.17-4 provides an example of an EDTO release statement adapted to aeroplanes with more than two engines (assuming that the EDTO threshold has been set at 180 minutes).

4.17.4.5 As shown in Figure 4.17-4, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is capable of EDTO; and

b) its maximum AEO time capability is 300 minutes.

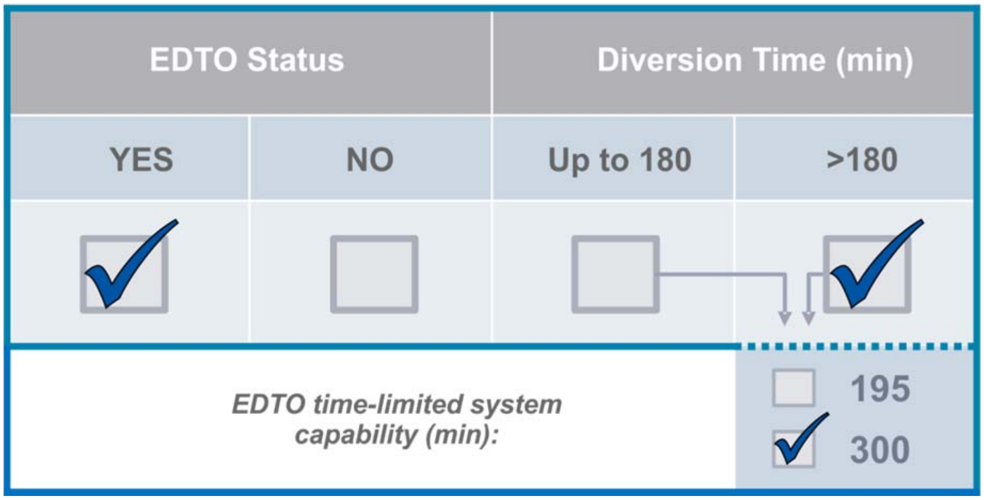

Figure 4.17-4. Example of EDTO release statement (aeroplane with more than two engines)

4.17.4.6 In Figure 4.17-5, the EDTO status of the concerned aeroplane is as follows:

a) the aeroplane is restricted to non-EDTO operations; and

b) its maximum AEO time capability is 195 minutes.

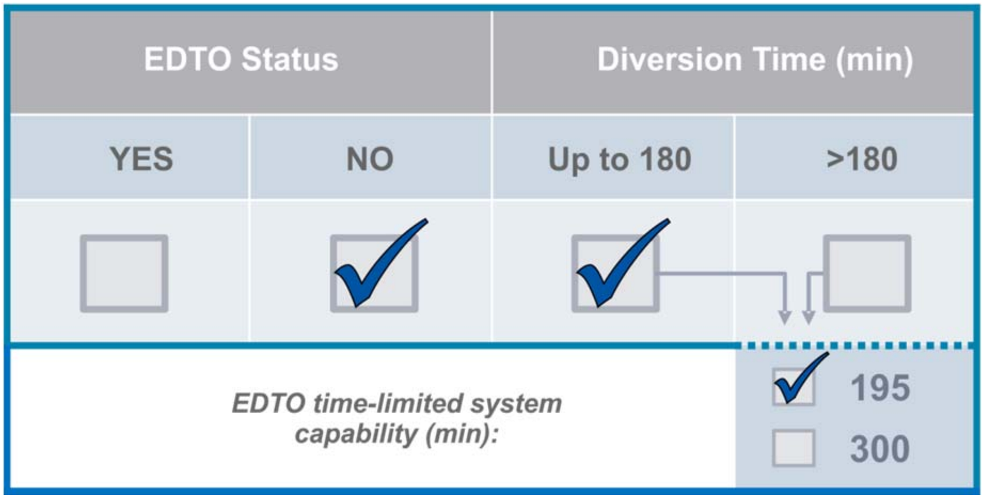

Figure 4.17-5. Example of non-EDTO release statement (aeroplane with more than two engines)

4.18 EDTO TRAINING

4.18.1 EDTO operators should create an EDTO training programme to support EDTO qualifications but also to educate personnel on the special nature of EDTO and to assure that EDTO programme tasks are properly accomplished. This training course is an integral part of the operator's EDTO maintenance programme as defined in Section 4.2 and may be in addition to any specific aeroplane technical training required for the position. The course is to ensure that all personnel who have assigned EDTO responsibilities are provided with the necessary training so that EDTO tasks are properly planned and accomplished. The course should be approved by the national authority and written into the EMPM.

4.18.2 The training programme should include consideration of any contracted maintenance provider and contain the process of qualification of individuals. The EMPM should define how the training records are tracked and stored, and a notification process should be implemented to notify qualified personnel when training is required. The process of delegating any training should be defined in the EMPM. Any recurrent training requirements should be included in the description.

4.18.3 The EDTO maintenance training should cover:

a) *initial training* to ensure that all maintenance personnel have the knowledge, skills and ability to perform an adequate EDTO technical procedure for the specific AEC; and

b) *recurrent training* to ensure that all maintenance personnel maintain and update, if necessary, their awareness of EDTO maintenance specificities.

4.18.4 If recurrent training is part of the operator-approved programme, the recurrent time line should be defined in the programme, and a notification system should be in place to notify personnel and management of any required training. A process should be in place to manage contract maintenance personnel as personnel change due to attrition. Recurrent training can be accomplished through a test process and controlled through management personnel at the individual stations. Failure of this test requires the staff to retake the training programme.

4.18.5 This EDTO training programme should typically include:

a) introduction to EDTO regulations;

b) focus on applicable elements of national EDTO regulation;

c) overview of EDTO certification of twin-engine aircraft;

d) EDTO significant systems;

e) EDTO authorization (maximum diversion times, TLSs, operator's approved diversion time, EDTO routes, EDTO MEL);

f) CMP and EDTO maintenance programme;

g) EDTO pre-departure service check (including the EDTO maintenance release, see 4.17);

h) EDTO reliability programme procedures, for example, (as applicable):

- Parts control programme (see 4.8);
- EDTO service check (see 4.9);
- Reliability programme (see 4.10);
- Propulsion system monitoring (see 4.11);
- Verification programme (see 4.12);
- Dual maintenance limitations (see 4.13);
- Engine condition monitoring (see 4.14);
- Oil consumption monitoring (see 4.15); and
- APU in-flight start monitoring programme (see 4.16);

i) additional procedures for EDTO (as applicable).

4.18.6 The training format can be created as an instructor-led course or as a computer-based training course and should include the general nature of EDTO. The programme should also reflect the specific operator EDTO maintenance programme requirements. As revisions to the EMPM are developed, the training programme should be revised to include any major changes to the EDTO maintenance programme.

4.18.7 The training course can be created by the operator or it can be contracted for development from an outside source. In either case, the programme is the responsibility of the operator and should have the authorization of the national authority.

4.18.8 The operator determines the level of qualification required for EDTO signature authority which should be defined in the EMPM and approved by the CAA. The specific theoretical, practical, and/or process training should be defined in the associated syllabus. EDTO training may not differ greatly between aeroplane models but those differences should be defined in the programme. The intent is not to revise the training programme for small administrative changes to the EMPM but to focus on major changes to the programme driven by a new procedure or process.

— END —

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