



Safety Criteria for Approval of Extended Range Twin-Engine Operations (ETOPS)



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Transport, 1996.

This publication may be reproduced without permission provided the source is fully acknowledged.

TP 6327E
(06/2007)

TC-1002271

FOREWORD

TP 6327, Safety Criteria For Approval of Extended Range Twin-Engine Operations (ETOPS), is published by Transport Canada Safety and Security under the authority of the Director General, Civil Aviation by the Director, Standards in co-ordination with the Director, Aircraft Certification.

This publication has been prepared for use and guidance of Canadian air operators operating, or seeking authority to operate, two-engine aeroplanes more than 60 minutes at the one-engine-inoperative cruise speed, from an adequate airport on routes that are not wholly within Canadian Domestic Airspace.

This ETOPS document will be amended as engineering data and practical operational experience dictate. Policy and terms of reference in this publication supersede previous directives.

The Office of Primary Interest is the Certification and Operational Standards Division of the Standards Branch.

Original signed by

Don Sherritt

Director Standards

ACKNOWLEDGEMENT/REFERENCE

Some paragraphs or statements contained in this manual may be copied in whole or in part from other documents such as the Canadian Aviation Regulations (CARs), the Canada Air Pilot (CAP), the Aeronautical Information Manual (AIM), the Federal Aviation Regulations (FARs), the Joint Aviation Requirements (JARs), the FAA Advisory Circular 120-42A, JAA Guidance and Information, Airbus or Boeing publications etc. without specific reference to the source document. The information was copied, in some cases in order to avoid perceived contradiction between documents, and in other cases, in an effort to harmonize our requirements with those of other Civil Aviation Authorities.

Since specific reference to the source document would have served no purpose and would have likely caused clutter in the text, it was left out and replaced by this acknowledgement.

RECORD OF AMENDMENTS

2007 EDITION

Amendment No.	Date	Pages Affected	Initials
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			

Intentionally left blank

TABLE OF CONTENTS

FOREWORD.....	I
ACKNOWLEDGEMENT/REFERENCE.....	II
RECORD OF AMENDMENTS	III
DEVELOPMENT	VIII
DEFINITIONS	IX
ABBREVIATIONS	XIII
CHAPTER 1 – POLICY AND GENERAL INFORMATION	XIV
1.1 GENERAL	1-1
1.2 APPLICABILITY	1-1
1.3 REFERENCE REGULATIONS	1-1
1.4 APPROVAL PROCEDURES	1-1
1.5 CONTINUITY OF ETOPS.....	1-2
CHAPTER 2 – DESIGN FEATURES CRITERIA	2-1
2.1 GENERAL	2-1
2.2 TYPE DESIGN APPROVAL	2-1
2.3 CRITERIA	2-1
2.3.2 AIRFRAME SYSTEMS (GENERAL)	2-2
2.3.3 PROPULSION SYSTEMS	2-2
2.3.4 AUXILIARY POWER UNIT	2-2
2.3.5 COMMUNICATION, NAVIGATION AND BASIC FLIGHT INSTRUMENTS ...	2-2
2.3.6 CABIN PRESSURIZATION	2-2
2.3.7 CABIN HEATING/COOLING	2-2
2.3.8 EQUIPMENT COOLING	2-2
2.3.9 CARGO COMPARTMENT.....	2-3
2.3.10 ICE PROTECTION.....	2-3
2.3.11 ELECTRICAL POWER.....	2-3
2.3.12 HYDRAULIC POWER AND FLIGHT CONTROLS	2-3
2.3.13 TIME LIMITED SYSTEMS	2-4
2.3.14 FUEL SYSTEM	2-4
2.3.15 MONITORING SYSTEMS	2-4
2.4 ENROUTE FLIGHT PATHS	2-4

CHAPTER 3 – OPERATIONAL APPROVAL CRITERIA 3-1

3.1	GENERAL	3-1
3.2	OPERATIONAL APPROVAL CONSIDERATIONS	3-1
3.2.1	BENIGN AREA OF OPERATION	3-1
3.2.2	DEMANDING AREA OF OPERATIONS	3-1
3.3	ACCELERATED ETOPS APPROVAL	3-4
3.4	FLIGHT PREPARATION AND IN-FLIGHT CONSIDERATIONS	3-4
3.4.1	GENERAL	3-4
3.4.1.1	Time limited system planning	3-4
3.4.2	MINIMUM EQUIPMENT LIST (MEL)	3-5
3.4.3	ETOPS SIGNIFICANT EVENT DURING FLIGHT	3-5
3.4.4	COMMUNICATION AND NAVIGATION FACILITIES	3-5
3.4.5	FUEL AND OIL SUPPLY	3-6
3.4.6	ETOPS ALTERNATE AIRPORTS	3-8
3.4.7	AEROPLANE PERFORMANCE DATA	3-11
3.4.8	NAVIGATION DOCUMENTATION	3-11
3.5	TRAINING AND EVALUATION PROGRAM	3-11
3.6	OPERATIONAL LIMITATIONS	3-11
3.6.1	AREAS OF OPERATION	3-11
3.6.2	FLIGHT DISPATCH LIMITATION	3-12
3.6.3	USE OF STANDARD MAXIMUM DIVERSION TIME	3-12
3.6.4	PILOT-IN-COMMAND AUTHORITY	3-12
3.7	OPERATIONS MANUAL	3-12
3.8	OPERATIONS SPECIFICATIONS	3-12

CHAPTER 4 – ETOPS MAINTENANCE AND RELIABILITY REQUIREMENTS..... 4-1

4.1	GENERAL	4-1
4.2	MAINTENANCE CONTROL SYSTEM	4-1
4.3	MCM REQUIREMENTS FOR ETOPS	4-1
4.4	OIL CONSUMPTION	4-2
4.5	ENGINE CONDITION AND TREND MONITORING (ECTM)	4-2
4.6	VERIFICATION PROGRAM	4-2
4.7	RELIABILITY PROGRAM	4-2
4.7.6	THE REPORT MUST ALSO IDENTIFY THE FOLLOWING:	4-3
4.8	CONTRACTED MAINTENANCE AND RELIABILITY	4-3
4.9	PROPULSION SYSTEM MONITORING	4-4
4.10	TECHNICAL TRAINING	4-4
4.11	ETOPS PARTS CONTROL	4-4

APPENDIX A – PROPULSION SYSTEM RELIABILITY ASSESSMENT	A-1
A.1 GENERAL	A-1
A.1.1 TYPE DESIGN APPROVAL	A-1
A.1.2 OPERATIONAL APPROVAL	A-1
A.2 CONCEPTS AND CRITERIA.....	A-1
A.3 ASSESSMENT	A-1
A.3.1 DATA REQUIREMENTS	A-1
A.3.2 EXPERIENCE.....	A-2
A.3.3 ENGINEERING ASSESSMENT.....	A-2
A.4 PROPULSION SYSTEM RELIABILITY OBJECTIVE.....	A-3
A.4.1 TYPE DESIGN	A-3
A.4.2 OPERATIONS	A-3
APPENDIX B – ETOPS ALTERNATE AIRPORT	B-1
B.1 GENERAL	B-1
B.2 ADEQUATE AIRPORT	B-1
B.3 ETOPS ALTERNATE AIRPORT.....	B-1
B.4 ETOPS ALTERNATE AIRPORT WEATHER MINIMA	B-2
APPENDIX C – ACCELERATED ETOPS OPERATIONAL APPROVAL	C-1
C.1 GENERAL	C-1
C.2 POLICY	C-1
C.2.1 ETOPS PROCESS.....	C-1
C.2.2 APPLICATION	C-2
C.2.3 OPERATIONAL APPROVALS	C-3
C.2.4 PROCESS VALIDATION	C-3
C.2.5 ACCELERATED ETOPS SURVEILLANCE	C-4
C.2.6 MINIMUM REQUIREMENTS	C-5
APPENDIX D – SIMULATED ETOPS PROGRAM.....	D-1
D.1 GENERAL	D-1
D.2 IN SERVICE EXPERIENCE REQUIREMENTS.....	D-1
D.3 APPLICATION	D-1
D.4 AUTHORITY	D-2
D.5 FLIGHT SAFETY.....	D-2
D.6 SIMULATION/DEMONSTRATION PROGRAM REQUIREMENTS.....	D-2
D.7 CONCEPT FOR SIMULATION	D-3
D.8 CONCEPT FOR DEMONSTRATION.....	D-5
D.9 CONCEPTS FOR PAPER AIRLINE EVALUATION	D-6
D.10 ETOPS VALIDATION FLIGHT	D-7

DEVELOPMENT

This manual has been produced with the participation and co-operation of members of the Aviation industry and the following Branches of Transport Canada Civil Aviation:

Aircraft Certification, Flight Test	(AARDC)
Aircraft Certification, Powerplants and Emissions.....	(AARDD/P)
Aircraft Certification, Fuel and Hydromechanical Systems	(AARDD/M)
Aircraft Certification, Avionics and Electrical Systems	(AARDD/A)
Aircraft Certification, Occupant Safety and Environmental Systems.....	(AARDD/O)
Aircraft Certification Standards.....	(AARTC)
Maintenance and Manufacturing Operation Standards.....	(AARTO)
Maintenance and Manufacturing Standards and Technical Program	(AARTM)
Certification and Operational Standards.....	(AARTF)
National Operations Airlines Division	(AAROA)

DEFINITIONS

The following is a list of definitions applicable in the context of this manual only. Words, such as “Airport” may be found in other publications with a different definition.

AIRCRAFT FLIGHT MANUAL

The term Aircraft Flight Manual is defined in CAR 101.01, and is used in lieu of the terms “Airplane Flight Manual” and/or “Approved Flight Manual”.

AIRPORT

ADEQUATE AIRPORT:

For the purpose of ETOPS, an adequate airport means one at which the landing performance requirements at the expected landing weight can be met and which is expected to be available, if required, and which has the necessary facilities and services, such as air traffic services, lighting, communications, meteorological services, navigation aids, aeroplane rescue and fire-fighting services and at least one suitable instrument approach procedure which is usable by the aeroplane.

ETOPS ALTERNATE AIRPORT:

For the purpose of ETOPS, an ETOPS alternate airport means an adequate airport that is listed in the air operator’s company operations manual and that meets the applicable requirements of Section 3.4.6 of this manual.

BENIGN AREA OF OPERATION

An area that provides numerous adequate airports, a high level of reliability and availability of communication, navigation and ATC services and facilities, and where prevailing weather conditions are stable and generally do not approach extremes in temperature, wind, ceiling, and visibility. (The Caribbean Sea meets this criteria).

CONFIGURATION, MAINTENANCE AND PROCEDURES (CMP) STANDARDS

A document containing the minimum requirements for the aircraft configuration including any special inspections, maintenance tasks, hardware life limits and Master Minimum Equipment List (MMEL) constraints necessary to establish and maintain the suitability of an airframe-engine combination for ETOPS operations.

CRITICAL POINT (CP)

A “critical point” is the point along a route which is most critical from a fuel requirement point of view, from which an aeroplane can proceed toward the destination or initiate a diversion to another airport. (The CP is usually, but not always, the last ETP).

DEMANDING AREA OF OPERATION

An area that has one or more of the following characteristics:

1. Prevailing weather conditions can approach extremes in winds, temperature, ceiling, and visibility for prolonged period of time;
2. Few alternate airports;
3. Due to remote or overwater area, a high level of reliability and availability of communications, navigation, and ATC services may not exist.

ENGINE

The basic engine assembly plus its essential accessories as supplied by the engine manufacturers.

ENGINEERING JUDGMENT

A subjective decision required due to the complexity of an issue based upon a qualitative analysis of relevant data.

EQUAL TIME POINT (ETP)

An Equal Time Point is a point along the route which is located at the same flight time from two airports.

ETOPS SIGNIFICANT SYSTEM

ETOPS Significant Systems means the aeroplane propulsion system and any other aeroplane systems whose failure could adversely affect the safety of an ETOPS flight, or whose functioning is important to continued safe flight and landing during an aeroplane extended diversion

Information Note:

Each ETOPS significant system is either a Group 1 or Group 2 system

ETOPS Group 1 System:

- (1) A system for which the fail-safe redundancy characteristics are directly linked to the number of engines;
- (2) A system that may affect the proper functioning of the engines to the extent that it could result in an in-flight shutdown or uncommanded loss of thrust;
- (3) A system which contributes significantly to the safety of an engine inoperative ETOPS diversion and is intended to provide additional redundancy to accommodate the system(s) lost by the inoperative engine. These include back-up systems such as an emergency generator or APU; or
- (4) Any system essential to prolonged operation at engine inoperative altitudes including anti-icing systems for a twin engine aeroplane if single engine performance results in the aeroplane operating in the icing envelope.

ETOPS Group 2 System:

Group 2 System is an ETOPS significant system that is not a Group 1 system.

ETOPS OPERATIONS

For the purpose of this document, ETOPS operations are those operations conducted with a twin-engine aeroplane over a specified route that contain a point further than 60 minutes flying time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate airport.

ETOPS AREA OF OPERATION

The area in which an air operator is authorized to conduct a flight under ETOPS regulations. It is defined by circles centered on the adequate airports, the radius of which is the allowed maximum diversion distance (maximum diversion distance equals approved maximum diversion time multiplied by the approved one-engine-inoperative cruise speed).

ETOPS ENTRY POINT (EEP)

The EEP is the first point on the aeroplane's outbound route beyond which the aeroplane is no longer continuously within 60 minutes flying time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate airport.

ETOPS EXIT POINT (EXP)

The EXP is the first point on the aeroplane's inbound route where the aeroplane is continuously within 60 minutes flying time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate airport.

ETOPS SEGMENT

The ETOPS segment starts at the EEP and ends at the EXP.

ETOPS SIGNIFICANT EVENT

An ETOPS significant event is any system malfunction, degradation or other in-flight event, which requires that the crew make a decision whether to turn back, divert or to continue under an increased level of alertness.

FAIL-SAFE

Fail-safe is the design methodology upon which Airworthiness Standards for Transport Category Aeroplanes are based. It requires that the effect of failures and combinations of failures to be considered in defining a safe design.

FUEL CONSUMPTION MONITORING PROGRAM

Is a program established by the air operator to monitor the aeroplane's in-service deterioration in cruise fuel burn performance.

IN-FLIGHT SHUTDOWN (IFSD)

When an engine ceases to function in-flight and is shut down, for any reason (Ex: a flameout, internal failure, crew-initiated shut-off, foreign object ingestion, icing, etc.) or power reduction which results in an unacceptable thrust loss.

POWER PLANT

A system consisting of an engine and all ancillary components installed on the engine prior to installation on the aeroplane to provide and control power/thrust and for the extraction of energy.

PROCESS

A process is a series of steps or activities that are accomplished, in a consistent manner, to assure that a desired result is attained on an ongoing basis.

PROVEN PROCESS

A process is considered to be proven when the following elements are developed and implemented:

- (1) Definition and documentation of process elements.
- (2) Definition of process related roles and responsibilities.
- (3) Procedure for validation of process or process elements:
 - (i) Indications of process stability/reliability;
 - (ii) Parameters to validate process and monitor (measure) success;
 - (iii) Duration of necessary evaluation to validate process.
- (4) Procedure for follow-up in-service monitoring to assure process remains reliable/stable.

SINGLE ENGINE CRUISE SPEED (OR ONE-ENGINE-INOPERATIVE CRUISE SPEED)

1. The approved one-engine-inoperative cruise speed for the intended area of operation must be a speed, within the certified limits of the aeroplane, selected by the air operator and approved by Transport Canada Civil Aviation (TCCA).
2. This speed must be used for:
 - i) Establishing the area of ETOPS operations and any dispatch limitations;
 - ii) Calculation of one-engine-inoperative fuel requirements under paragraph 3.4.5 (Fuel and Oil Supply) of this document; and
 - iii) Establishing the level off altitude (net performance) data. This level off altitude (net performance) must clear any obstacles en route by margins as specified in applicable operating rules.

SYSTEM

A system includes all elements of equipment necessary for the control and performance of a particular major function. It includes both the equipment specifically provided for the function in question and other basic equipment such as that required to supply power for the equipment operation.

1. **Airframe System** – any system on the aeroplane that is not a propulsion system.
2. **Propulsion System** – the aeroplane power plant installation including each component that: is necessary for propulsion, affects the control of the major propulsion units or affects the safety of the major propulsion units (Airworthiness Manual 525.901(a)).

UNACCEPTABLE THRUST LOSS

Total thrust loss or loss of thrust to an extent that would preclude continued controlled flight with the affected engine to an adequate airport, should the other engine fail.

ABBREVIATIONS

ACARS	Airborne Communication And Reporting System
AFM	Aircraft Flight Manual
APU	Auxiliary Power Unit
ATC	Air Traffic Control
BECMG	Becoming (Weather)
CDL	Configuration Deviation List
CMP	Configuration, Maintenance and Procedures Manual
CP	Critical Point
EEP	Extended Range Entry/Exit Point
ER	Extended Range
ETP	Equal Time Point
EXP	Extended Range Exit Point
HAT	Height Above Threshold
HAA	Height Above Airport
IFSD	In-flight Shut Down
IPC	Illustrated Parts Catalogue
MCTOW	Maximum Certified Take-off Weight
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
PMI	Principal Maintenance Inspector
POI	Principal Operations Inspector
PROB	Probability (Weather)
PSRA	Propulsion System Reliability Assessment
RAT	Ram Air Turbine
STC	Supplemental Type Certificate
TC	Type Certificate
TEMPO	Temporary (Weather)

Intentionally left blank

CHAPTER 1 – POLICY AND GENERAL INFORMATION

1.1 GENERAL

- 1.1.1** This manual provides the standard, policy, procedures and guidelines for obtaining Type Design and/or Operational Approval for two-engine transport category aeroplanes to operate over a specified route containing a point farther than 60 minutes flying time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate airport regardless of terrain. The 60 minute threshold is a point beyond which the provisions of this publication apply. Previously issued approvals for ETOPS programs continue to be valid; requests for new ETOPS authorizations or changes to existing programs will be assessed under the criteria outlined in this manual. Specific criteria are included for diversion time of 75, 90, 120, or 180 minutes and beyond.

1.2 APPLICABILITY

- 1.2.1** This manual* applies to all twin-engine aeroplanes with a MCTOW of more than 8618 kilograms (19,000 pounds) for which a Canadian type certificate has been issued authorizing the transport of 20 or more passengers (whether or not the individual aeroplane is configured for 20 or more passengers) operated by a Canadian air operator in an air transport service. ETOPS does not apply to flights conducted wholly within Canadian Domestic Airspace.

* **NOTE:** Transport Canada's Web site still publishes the previous version of TP 6327 because Chapter 2 of each publication is applicable to the aeroplane types for which an ETOPS certification application was submitted to the airworthiness authority having jurisdiction in the State of Design during the applicable dates of the TP 6327 version. The applicability of Chapter 2 is consistent with the applicability for approval of, or changes to, the type design of an aeronautical product, under Part V of the Canadian Aviation Regulations (CARs).

1.3 REFERENCE REGULATIONS

- 1.3.1** This document is enabled by Paragraph 705.26 (2)(c) of the Canadian Aviation Regulation.

1.4 APPROVAL PROCEDURES

- 1.4.1** Requests for approval for ETOPS operations with two-engine aeroplanes must be submitted, with the required supporting documentation to the applicable TCCA office at least 90 days prior to the proposed start of ETOPS operations.
- 1.4.2** The Aeroplane type design must meet the requirements for ETOPS design features and criteria specified in Chapter 2 (Design Features Criteria) of this manual unless another Standard is available.

Despite the above, ETOPS type design approval is not required for air operators requesting approval to conduct 75 minute operations in Benign Areas of Operations. The airframe-engine combination and the general scope of the operation will be reviewed by the POI and the PMI to determine if there are any factors that could affect the safe conduct of operations before an Operations Specification (Ops Spec) is issued.

1.4.3 In addition, for ETOPS operations other than 75 minutes Benign Area of Operation, the following criteria must be met prior to conducting ETOPS operations:

- a) Satisfy the operational approval considerations (Operational Approval Criteria) specified in Chapter 3 of this manual;
- b) Have a system to maintain and dispatch an ETOPS aeroplane in accordance with an approved maintenance, reliability and training program that includes ETOPS requirements specified in Chapter 4 of this manual, (ETOPS Maintenance and Reliability Requirements);
- c) Demonstrate that the maintenance checks, servicing, and programs called for in Chapter 4 of this manual are properly conducted;
- d) Demonstrate that ETOPS flight release practices, policies, and procedures are established; and,
- e) Conduct an operational validation flight, in the aeroplane or an approved simulator (as determined by Transport Canada, Civil Aviation (TCCA) on a case-by-case basis), where demonstration of the following emergency conditions must be incorporated;
 - i) Total loss of thrust of one engine;
 - ii) Total loss of normal generated electrical power;
 - iii) Total loss of pressurization; and
 - iv) Any other event or condition considered to be equivalent in operational challenge, safety management, crew workload or performance risk.

When the foregoing has been reviewed and found acceptable, a recommendation from the Principal Maintenance Inspector (PMI) and the Principal Operating Inspector (POI) will be forwarded to the responsible Manager, for approval and the applicant will be issued an Operations Specification to conduct ETOPS operations within specified limitations.

1.5 CONTINUITY OF ETOPS

1.5.1 Due to the special nature of ETOPS continuous processes, procedures and training are required to be maintained once ETOPS approval is issued.

1.5.2 Subject to the Subsection 1.5.3, where an air operator ceases actual ETOPS operations for a period exceeding 13 months, application for re-instatement must be submitted in accordance with section 1.4 of this document.

1.5.3 Where an air operator ceases actual ETOPS operation for a period exceeding 13 months but maintains simulated ETOPS processes, procedures and training as prescribed in this manual, the ETOPS approval may be maintained until actual ETOPS operation is resumed.

However, when actual ETOPS operation resumes following a period of actual ETOPS inactivity that exceeds 13 months, a recurrent training must be completed by each flight crew member as per the requirements of Subsection 725.124(36) of the Commercial Air Service Standards (CASS) and an ETOPS recurrent must be completed by each flight dispatcher as per the requirement of Paragraph 725.124(21)(t) of the Commercial Air Service Standards (CASS).

CHAPTER 2 – DESIGN FEATURES CRITERIA

2.1 GENERAL

- 2.1.1** A determination must be made that the design features for a new transport category type design aeroplane intended to be used in ETOPS are suitable for such operations. In the event that an existing aeroplane's operation is expanded to include ETOPS operations, a re evaluation of some design features may be necessary.
- 2.1.2** Modifications to some systems may be required to achieve the desired reliability. In both cases ETOPS significant systems and propulsion systems for the particular airframe engine combination must 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.

2.2 TYPE DESIGN APPROVAL

- 2.2.1** Upon satisfactory completion of an engineering type design review and test program, which may include a Certification Flight Test evaluation, an ETOPS type design approval is issued. The Aircraft Flight Manual (AFM) or Supplement and Type Certificate (TC) or Supplemental Type Certificate (STC) must contain the following pertinent information:
- a) Special limitations, including any limitations associated with operation of the aeroplane up to the maximum diversion time being approved;
 - b) The airborne equipment, installation, and flight crew procedures required for ETOPS operations;
 - c) Revision to the performance section including fuel consumption rates;
 - d) Markings or placards;
 - e) The maximum diversion time capability of the aeroplane for ETOPS as required by the Time Limited Systems of this manual in accordance with Subparagraph 525.1581(a)(2) of the Airworthiness Manual, Chapter 525; and
 - f) The following statement: "The type design reliability and performance of this airframe-engine combination has been evaluated in accordance with the "Safety Criteria for Approval of Extended Range (Twin Engine) Operations – TP 6327" and found suitable for (state maximum diversion time) ETOPS operations with the incorporation of the approved aeroplane configuration CMP standard contained in (state description or reference to a document containing the approved CMP standard). This finding does not constitute approval to conduct ETOPS."

2.3 CRITERIA

- 2.3.1** The evaluation of failures and failure combinations must be based on engineering judgment and acceptable fail safe methodology. The analysis should consider effects of operations with one engine inoperative, including allowance for damage that could result from failure of the first engine. Unless it can be shown that equivalent safety levels are provided or the effects of failure are minor, failure and reliability analysis should be used as guidance in verifying that the proper level of fail-safe design has been provided.

2.3.2 AIRFRAME SYSTEMS (GENERAL)

- a) Airframe systems must be shown to comply with section 525.1309 of the Airworthiness Manual, Chapter 525
- b) Extended duration of single engine operations must not require exceptional piloting skills and/or crew coordination. Considering the resulting degradation of the performance of the aeroplane type with an engine inoperative, the increased flight crew workload and the malfunction of remaining systems and equipment, the impact on flight crew procedures must be minimized. Consideration must also be given to the effects of continued flight with an engine and/or airframe systems inoperative on the flight crew's and/or passengers' physiological needs.

2.3.3 PROPULSION SYSTEMS

- a) The propulsion system must be shown to comply with section 525.901 of the Airworthiness Manual, Chapter 525
- b) In order to maintain a level of safety, consistent with other aeroplane systems, it is necessary to have an acceptably low risk of double propulsion system failure for all design and operational related causes. This implies a relationship between propulsion system reliability and maximum approved diversion time.
- c) It must be shown that the propulsion system reliability has reached an acceptable level for ETOPS as determined in accordance with Appendix A of this manual.

2.3.4 AUXILIARY POWER UNIT

If an APU is required to satisfy the type design criteria for ETOPS, the installation must meet:

- 1) The applicable Airworthiness Manual Chapter 525 requirements; and
- 2) Any additional requirements necessary to demonstrate its ability to perform the intended function, i.e. start reliability, altitude, bleed air capability etc...

2.3.5 COMMUNICATION, NAVIGATION AND BASIC FLIGHT INSTRUMENTS

It must be shown that, under all combinations of propulsion and/or airframe system failures, which are not extremely improbable, reliable communication, accurate and appropriate navigation, and basic flight instruments needed to comply with contingency procedures for ETOPS will be available.

2.3.6 CABIN PRESSURIZATION

- a) A review of fail-safe redundancy features must show that the loss of cabin pressure is improbable under single engine conditions.
- b) Aeroplane performance data must be provided to verify the ability for continued safe flight and landing after loss of cabin pressure and subsequent operation at a lower altitude.
- c) Unless it can be shown that cabin pressure can be maintained during single engine operation at the altitude required for continued flight to a ETOPS alternate airport, oxygen must be available to sustain the passengers and crew for the maximum diversion time.

2.3.7 CABIN HEATING/COOLING

The air conditioning system must be capable of providing a reasonable cabin temperature in the event of any single or combination of failures not shown to be extremely improbable.

2.3.8 EQUIPMENT COOLING

The data must establish that the required electronic equipment for ETOPS has the ability to operate acceptably with an engine shut down. Additionally, adequate indication of the proper functioning of the cooling system must be verifiable if required, to assure system operation prior to dispatch.

2.3.9 CARGO COMPARTMENT

The cargo compartment design and fire protection system capability must be consistent with the following:

- 1) **Design** – The cargo compartment fire protection system integrity and reliability must be suitable for the intended operations considering fire detection sensors, liner materials, etc...;
- 2) **Fire Protection** – An analysis or test must be conducted to show, considering approved maximum diversion time (under standard conditions in still air), (including an allowance for 15 minutes holding and/or an approach and landing), that the ability of the system to suppress or extinguish fires is adequate to ensure safe flight and landing at a ETOPS alternate airport; and
- 3) Main deck Class B cargo compartments (as defined in the Airworthiness Manual, Chapter 525, Section 525.857), with volumes in excess of 200 cubic feet, are to be modified to a Class C configuration or equivalent.

2.3.10 ICE PROTECTION

Airframe and engine ice protection systems must be shown to provide adequate protection capability (aeroplane controllability, etc.) for the intended operation. This must account for prolonged exposure to lower altitudes associated with one-engine-inoperative diversion, cruise, holding, approach, missed approach and landing.

2.3.11 ELECTRICAL POWER

- a) Three or more reliable and independent electrical power sources must be available, each capable of powering essential systems independently. If one or more of the required electrical power sources are powered by an APU, hydraulic system, or ram air turbine, the following criteria apply as appropriate:
 - 1) The APU, when installed, must meet the criteria in Subsection 2.3.4 of this manual;
 - 2) The hydraulic power source must be reliable. To achieve this reliability, it may be necessary to provide two or more independent energy sources (e.g. bleed air from two or more pneumatic sources); and
 - 3) Ram air turbine deployment must be demonstrated to be sufficiently reliable and not require main electrical or engine dependent power for deployment.
- b) In the event of any single failure or combination of failures not shown to be extremely improbable, it must be shown that electrical power is capable of providing for:
 - 1) Essential flight instruments, avionics, communications, navigation, supportive systems and any other equipment deemed necessary for ETOPS operations for continued safe flight and landing;
 - 2) Crew cockpit information of sufficient accuracy for the intended operation; and
 - 3) Instruments and equipment needed to allow the flight crew to cope effectively with adverse conditions.

2.3.12 HYDRAULIC POWER AND FLIGHT CONTROLS

- a) Consideration of these systems may be combined, since many commercial aeroplanes have full hydraulically powered or “fly-by-wire” controls. For aeroplanes with these types of flight controls, evaluation of system redundancy must show that single failures or failure combinations not shown to be extremely improbable do not preclude continued safe flight and landing.
- b) As part of this evaluation, the loss of any two hydraulic systems and any engine should be assumed to potentially occur unless it is established during failure evaluation that there are no sources of damage or the location of the damage sources are such that this failure condition will not occur.

2.3.13 TIME LIMITED SYSTEMS

For each ETOPS Significant System that is time limited, the system capability must be defined. The most limiting ETOPS Significant System capability must be stated in the Aircraft Flight Manual as per the requirements of Subsection 2.2.1 in this manual.

2.3.14 FUEL SYSTEM

The aeroplane fuel feed system must be able to supply fuel to the engine in accordance with sections 525.951 and 525.955 of the Airworthiness Manual, Chapter 525 for all fuel pump power supply failure configurations not shown to be Extremely Improbable. (i.e. the power supply to the fuel boost pumps must be available for all power supply failure conditions not shown to be Extremely Improbable.) The fuel necessary to complete the ETOPS flight must be available to the operating engine(s) under any failure condition not shown to be Extremely Improbable. (e.g. crossfeed valve failures, automatic fuel management system failures, etc...).

If suction feed (i.e. fuel feed without boost pumps operating) is considered to be a means by which normal fuel feed pressures can be maintained:

- a) Testing should be performed covering worst-case cruise and diversion conditions, with respect to;
 - Fuel grade and temperature;
 - Thrust variations;
 - Turbulence and Negative G forces;
 - Fuel system components degraded within their approved maintenance condition; and
- b) The unusable fuel quantity in the suction feed configuration should be used when calculating fuel reserve quantity.

2.3.15 MONITORING SYSTEMS

Adequate status monitoring information and procedures on all ETOPS significant systems are required to be available for the flight crew to make pre flight go/no go decisions and in-flight diversion decisions.

Adequate fuel quantity and fuel used information must be available to the flight crew, including alerts, and advisories, that consider the fuel required to complete the flight, abnormal fuel management or transfer between tanks, and possible fuel leaks in the tanks, the fuel lines and other fuel system components and the engines.

2.4 ENROUTE FLIGHT PATHS

2.4.1 For aeroplanes for which ETOPS approval is required, the flight path, range performance and fuel flow must be determined at each weight, altitude and temperature within the operating limits established for the aeroplane. The flight path and range performance must be determined for each selected configuration with:

- a) The critical engine inoperative;
- b) The remaining engine at the available maximum continuous power or thrust;
- c) The means for controlling the engine supplied air-conditioned air to ensure a reasonable cabin temperature; and
- d) Consideration of the effects of icing on single engine performance.

CHAPTER 3 – OPERATIONAL APPROVAL CRITERIA

3.1 GENERAL

- 3.1.1** In considering an application from an air operator to conduct ETOPS operations, an assessment must be made of the air operator's overall safety record, past performance, flight crew training, flight dispatcher training, maintenance training and maintenance reliability programs. The data provided with the request must substantiate the air operator's ability to safely conduct and support these operations and must include the means used to satisfy the criteria outlined in this section and in Chapter 4 (ETOPS Maintenance and Reliability Requirements) of this manual.

3.2 OPERATIONAL APPROVAL CONSIDERATIONS

3.2.1 BENIGN AREA OF OPERATION

- a) Consideration is given to air operators requesting approval to conduct ETOPS operations within a Benign Area of Operation with minimal or no in-service experience with the airframe-engine combination. Although an ETOPS type design approval is not required, the airframe-engine combination is reviewed to determine if there are any factors that would affect the safe conduct of operations. Furthermore, flights must be operated at a weight that permits the flight, at the approved one-engine-inoperative cruise speed and power setting, to maintain-flight altitude at or above the Minimum Enroute Altitude (MEA);
- b) These approvals must be limited to a maximum diversion time of 75 minutes; and
- c) The maintenance control system must address factors that are significant to the 75 minutes Benign Area of Operation but a service check prior to the return flight may not be required.

3.2.2 DEMANDING AREA OF OPERATIONS

Each air operator requesting approval to conduct ETOPS operations within a Demanding Area of Operation must have, prior to commencement of ETOPS Operations, an ETOPS approved airframe-engine combination and approved Operation and Maintenance Control system which follow the standards prescribed in this manual. Furthermore, the requirements of Section 3.3 or the following minimum requirements must be satisfied:

1. For 90 minute approval

- i) A minimum of 3 months of domestic operating experience with the aeroplane-engine combination for which approval is requested;
- ii) An ETOPS type design approved for a minimum 120 minutes ETOPS criteria;
- iii) An approved CMP; and
- iv) A Minimum Equipment List requirement for 120 minutes "ER".

2. For 120 minute approval

- i) A minimum of 6 months of ETOPS operating experience with the aeroplane-engine combination for which approval is requested;
- ii) An ETOPS type design approved for a minimum 120 minutes ETOPS criteria;
- iii) An approved CMP; and
- iv) A Minimum Equipment List requirement for 120 minutes "ER".

3. For 138 minute approval

- a) Extension of ETOPS 120 minute approval;
 - i) A minimum of 3 months of 120 minute ETOPS operating experience with the aeroplane-engine combination for which approval is requested;
 - ii) Approved on a case by case basis;
 - iii) An ETOPS type design approved for a minimum 120 minute ETOPS criteria;
 - iv) An approved CMP;
 - v) An aeroplane time limited system capability not be less than the authorized 138 minute diversion time in still air conditions at the approved one engine inoperative cruise speed plus 15 minutes to allow for a hold, an approach and a landing;
 - vi) A Minimum Equipment List requirement modified to satisfy the MMEL policy for system component/relief for ETOPS operation beyond 120 minutes; and
 - vii) Flight crew, flight dispatcher and maintenance personnel training provided to address the differences between 120 minute and 138 minute approval.
- b) Use of 180 minutes ETOPS approval;
 - i) A minimum of 3 months of 120 minute ETOPS operating experience with the aeroplane-engine combination for which approval is requested;
 - ii) Exercised on an unlimited basis;
 - iii) An ETOPS type design approved for a minimum 180 minutes ETOPS criteria;
 - iv) An approved CMP;
 - v) A Minimum Equipment List requirement beyond 120 minutes “ER”; and
 - vi) Flight crew, flight dispatcher and maintenance personnel training provided to address the differences between 138 minute and the 180 minute approval.

4. For 180 minute approval

- i) A minimum of 12 months of 120 minute ETOPS operating experience with the aeroplane-engine combination for which approval is requested;
- ii) An ETOPS type design approved for a minimum 180 minute ETOPS criteria;
- iii) An approved CMP; and
- iv) A Minimum Equipment List requirement beyond 120 minutes “ER”.

5. For greater than 180 minutes approval

- i) Hold a current 180 minutes ETOPS approval with the aeroplane-engine combination for which approval is requested;
- ii) During flight planning, attempt to minimize the potential diversion time along the preferred track and plan the ETOPS flight at a maximum diversion distance of 180 minutes or less;
- iii) If conditions prevent the use of adequate airports within 180 minutes, as ETOPS alternates, the route may be flown beyond 180 minutes subject the requirements of the applicable specific area of operation specified in this Section;
- iv) The airframe-engine combination reviewed as per Chapter 2 of this manual to determine if there are any factors which would affect the safe conduct of the flight to be operated; and
- v) A Minimum Equipment List requirement for 180 minutes, including the following systems operational for dispatch;

- A) Fuel Quantity Indicating System (FQIS);
- B) APU Including electrical and pneumatic supply to its design capability;
- C) Auto throttle system;
- D) The communication system required by Subsection 3.4.4 of this manual; and
- E) One engine inoperative auto land capability (if flight planning is predicted on its use

Four specific area of operations beyond 180 minute approval

For flights operating in the North Pacific area, which for the purpose of this manual, is defined as the area covering the Pacific Ocean areas north of 40°N latitudes including NOPAC ATS routes and published PACOT track system between Japan and North America;

- i) To be operated only a case by case basis based on criteria set in the air operator's company operation manual when an ETOPS alternate airport is not available within 180 minutes in the North Pacific Area of operation;
- ii) The nearest available ETOPS alternate airport must be specified within 207 minutes maximum diversion time;
- iii) Air Traffic Services preferred tracking, if available, must be given first consideration;
- iv) Application of this approval must be limited to circumstances such as political or military concern, volcanic activity, airport weather below dispatch requirements, temporary airport condition and other weather related events;
- v) ETOPS type design must be approved for a minimum 180 minutes ETOPS criteria;
- vi) Approved CMP; and
- vii) The time required to fly the distance to the planned ETOPS alternate or the alternate, at the approved one engine inoperative cruise speed, in still air and standard day temperature, must not exceed the time specified in the Airplane Flight Manual for the airplane's most time limiting system time minus 15 minutes.

6. For 240 minutes approval

- i) ETOPS type design must be approved for a minimum 240 minutes ETOPS criteria;
- ii) Approved CMP;
- iii) Applicable to ETOPS operation with a maximum diversion time of 240 minutes on routes in the Pacific oceanic areas between the Canadian and United States west coast and Australia, New Zealand and Polynesia; South Atlantic oceanic areas; Indian Oceanic areas; oceanic areas between Australia and South America; and
- iv) Nearest available ETOPS alternates airports along the planned route of flight must be designated.

7. For greater than 240 minutes approval

- i) Minimum of 24 consecutive months of 180 minute ETOPS operating experience of which at least 12 consecutive month has been operated at 240 minutes on the airframe-engine combination for which the approval is requested;
- ii) Specific to operation between specific city pairs on routes in the Pacific Oceanic areas between Canada's west coast, Australia, New Zealand and Polynesia; South Atlantic oceanic areas; Indian Oceanic areas; oceanic areas between Australia and South America and South Pole areas;
- iii) Nearest available ETOPS alternates airports along the planned route of flight must be designated;

- iv) ETOPS type design must be approved for beyond 240 minutes ETOPS criteria; and
- v) Approved CMP

3.2.3 The initial in-service experience may be reduced in accordance with an Accelerated ETOPS Operational Approval (see Appendix C of this manual) in situations where an air operator can successfully demonstrate its ability and competence to achieve the necessary reliability required for ETOPS operations.

3.2.4 TCCA may require an increase in prerequisite in-service experience in cases where an abnormally low number of flights and/or ETOPS segments have occurred.

3.3 ACCELERATED ETOPS APPROVAL

3.3.1 The accelerated ETOPS Approval concept is based on a structured program of compensating factors and a step-by-step approach as outlined in Appendix C of this manual. This is the same philosophy as the technical transfer analysis used to accelerate the aeroplane ETOPS Type Design Approval.

3.3.2 The program is intended for an air operator to be able to demonstrate that the ETOPS process specified in Appendix C, Section 2.1 applicable to a specific airframe-engine combination, can be proven prior to actually operating under a specific ETOPS approval. The content of Appendix C is applicable only in consideration of granting an Operational Approval for an air operator intending to operate an airframe-engine combination, which has been awarded Type Design Approval including ETOPS.

3.4 FLIGHT PREPARATION AND IN-FLIGHT CONSIDERATIONS

3.4.1 GENERAL

The flight dispatch criteria specified herein are in addition to, or to amplify, the requirements contained in applicable operational rules and specifically apply to ETOPS operations. Although many of the criteria in this document are currently incorporated into approved programs for other aeroplanes or route structures, the nature of ETOPS necessitates that compliance with these criteria be re-examined in view of the operations to ensure that the approved programs are adequate for this purpose.

3.4.1.1 TIME LIMITED SYSTEM PLANNING

- a) For an ETOPS flight operating up to and including 180 minutes, the time required to fly the distance to the planned ETOPS alternate or alternates, at the approved one engine inoperative cruise speed in still air and standard day temperature, must not exceed the time specified in the AircraftFlight Manual for the airplanes most time limited system time minus 15 minutes;
- b) Except for the condition set out in Subparagraph 3.4.1.1.c), for an ETOPS flight operating beyond 180 minutes, the time required to fly the distance to the planned ETOPS alternate or alternates, at all engine operating cruise speed correcting for wind and temperature, must not exceed the time specified in the AircraftFlight Manual for the airplane's cargo fire suppression system minus 15 minutes; or
- c) Except for the condition set out in Subparagraph 3.4.1.1.b), for an ETOPS flight operating beyond 180 minutes, the time required to fly the distance to the planned ETOPS alternate or alternates, at the approved one engine inoperative cruise speed correcting for wind and temperature, must not exceed the time specified in the AircraftFlight Manual for the airplanes most time limited system time (except for cargo fire suppression) minus 15 minutes;

3.4.2 MINIMUM EQUIPMENT LIST (MEL)

- a) The specific ETOPS MEL criteria need not be applied for ETOPS operational approval in Benign Area of Operation (75 min.). For all ETOPS operations, the MEL must be based on the information contained within the aeroplane MMEL, the Type Certificate (TC) Supplement and the CMP document;
- b) System redundancy levels appropriate to the intended ETOPS Operations must be reflected in the Master Minimum Equipment List (MMEL) and/or TC Supplement. An air operator's MEL may be more restrictive than the MMEL considering the kind of ETOPS Operation being considered, and equipment and service problems unique to the air operator. For aeroplanes already in operational service, the existing MEL must be re evaluated and adjusted to reflect system redundancy level requirements for ETOPS; and
- c) For the purpose of ETOPS, a flight is deemed to be "Dispatched" from the moment the airplane starts its takeoff roll (Ref TP 9155 Section 3.15). It is only from this point that the Minimum Equipment List requirements do not apply.

3.4.3 ETOPS SIGNIFICANT EVENT DURING FLIGHT

- a) A list of systems that are considered ETOPS significant systems to the type and/or area of operation may be developed. If developed, it should be published in an appropriate document readily accessible to the flight crew, flight dispatchers and maintenance personnel. This list should contain applicable CMP standards, limitations and procedures in addition to information stating requirements and also reflect the type certificate holder's recommendations for any segments of the flight;
- b) This document should, based on available options at the time of the failure, give specific direction, for action required during any phases of flight. It is not intended to mandate MEL requirements for in-flight system failures, but to enhance the guidance to be provided to the flight crew after the completion of the applicable check list(s) (i.e. QRH, ECAM, ICAS, etc...) This list should consider all ATA Chapters. For items fully addressed by the check list (i.e. QRH, ECAM, ICAS, etc...) the list should contain a statement to that effect;
- c) In the occurrence of any ETOPS significant event in-flight prior to the ETOPS entry point, all available means of communication must be used by the flight crew to ensure assistance from the flight dispatcher to update and/or revise, if applicable, the flight plan as a result of re-evaluating the aeroplane's system capability to ensure that the flight can safely continue into the ETOPS area of operation; and
- d) A statement must be included to ensure that the Pilot in Command has the final authority in all phases of flight.

3.4.4 COMMUNICATION AND NAVIGATION FACILITIES

An aeroplane must not be dispatched on an ETOPS flight unless the requirements of the applicable regulations of the appropriate Subpart of the CARs have been met, and:

- 1) For all ETOPS operations where voice communication facilities are available, voice communication must be provided. While planning an ETOPS flight, an air operator must consider potential route and altitudes necessary for diversion to ETOPS alternate airports in determining whether voice communications facilities are available. Where voice communication facilities are not available or is of poor quality and voice communication is not possible, communications using alternative system must be substituted;
- 2) For ETOPS operation beyond 180 minutes, the aeroplane must be equipped with an additional communication system that is capable of providing immediate satellite based voice communication (SATCOM). The system must provide communication capability between the flight crew and air traffic control and the flight crew and the air operator's operational control center. While planning an ETOPS flight beyond 180 minutes, an air operator must consider potential route and altitudes necessary for diversion to ETOPS alternate airports in determining 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 must be substituted;

- 3) Communication facilities are available to provide, under normal conditions of propagation at the normal one engine inoperative cruise altitudes, reliable two-way communications between the aeroplane and the appropriate ground communication facility over the planned route of flight and the routes to any ETOPS alternate airport to be used in the event of diversion. It must 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;
- 4) 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 and altitudes to be used in the event of an engine shutdown;
- 5) Visual and non-visual aids are available at the specified ETOPS alternate airports as required for the authorized types of approaches and operating minima;and
6. Flights that are planned to be operated in an area of known or expected area of solar flare activity, cosmic radiation or radio blackout that may affect the operation of the aeroplane must be planned to avoid these areas based on criteria established in the air operator's company operation manual.

3.4.5 FUEL AND OIL SUPPLY

a) General

- 1) Unlike the area of operation, which is determined under standard conditions in still air, the fuel planning must consider the expected meteorological conditions along the planned route. Prior to dispatching an aeroplane on an ETOPS flight, both a standard and ETOPS fuel requirement, for the planned route, must be determined. The fuel quantity required for dispatch is the greater of the two resulting fuel requirements.
- 2) An aeroplane must not be dispatched on an ETOPS flight unless it carries sufficient fuel and oil to meet regulatory requirements of CAR 602.88 and CAR 705.25, including additional contingency fuel reserves that may be determined in accordance with Paragraph 3.4.5 b) (Critical fuel reserves). In computing fuel and oil requirements, at least the following must be considered:
 - i) Current forecast winds and meteorological conditions along the expected flight path at one engine inoperative cruising altitude and throughout the approach and landing;
 - ii) Any requirement for operation of ice protection systems and performance loss due to ice accretion on the unprotected surfaces of the aeroplane;
 - iii) Icing encounters must be conservatively factored to account for the likelihood of an encounter, threat severity, encounter duration and anticipated flight crew action;
 - iv) Any required operation of auxiliary power unit (APU);
 - v) Loss of aeroplane pressurization and air conditioning, with consideration must be given to flying at an altitude meeting oxygen requirements in the event of loss of pressurization;
 - vi) Upon reaching any of the ETOPS alternate airports, holding at 1500 feet above field elevation for 15 minutes and then initiating an instrument approach and landing;
 - vii) Navigational accuracy required;
 - viii) Any known Air Traffic Control (ATC) constraints; and

- ix) APU oil consumption and servicing must be considered in accordance with CMP document requirements.

b) Critical fuel reserves

In establishing the critical fuel reserves, the fuel necessary to fly from the most critical point to an ETOPS alternate airport under the conditions outlined in Paragraph 3.4.5 c), (Critical fuel scenario) must be determined. These critical fuel reserves should be compared to the fuel that will be on board at the most critical point based on a departure with the normal fuel required by regulations for the proposed trip. If it is determined by this comparison that the fuel that will be on board at the most critical point* is less than the critical fuel reserves, then additional fuel must be loaded to ensure that the fuel on board at the most critical point is equal to or greater than the critical fuel reserves.

* Note: In some rare cases, the minimum fuel to go from the second to last Equal Time Point (ETP) to the applicable ETOPS alternate airport is the same as the minimum fuel to go from the last ETP to the another ETOPS alternate airport. In those case each ETP constitute a critical point. The first critical point is the most critical until such time that the aeroplane has past the first critical point enroute to the second critical point, at which time the second critical point becomes the most critical point.

In consideration of the items listed in Paragraph 3.4.5 a), for an air operator with an approved fuel consumption monitoring program, the critical fuel scenario must allow for:

- 1) A contingency figure of 5 percent added to the calculated fuel burn from the critical point to a ETOPS alternate, to allow for errors in wind forecasts and fuel mileage, except when the air operator can demonstrate and justify with an assessment tool and supporting data specific for that route of flight, that each element which has an impact on safety has been identified and appropriate mitigating factors have been applied, use a contingency figure of 5 percent wind speed factor based on the actual forecast wind used to calculate fuel for the most critical fuel scenario in order to account for any potential errors in wind forecasting;
- 2) Any Configuration Deviation List (CDL) and/or Minimum Equipment List (MEL) items;
- 3) Fuel for engine anti-icing, and if applicable wing anti-ice, for the entire time during which icing is forecasted except when the air operator can demonstrate and justify with an assessment tool and supporting data specific to the aeroplane type for that route of flight, that each element which has an impact on safety has been identified and appropriate mitigating factors have been applied, fuel for the effect of 10 percent of the time during which icing is forecast including the fuel used by engine and wing anti-ice during this period;
- 4) Ice accretion on unprotected surfaces if icing conditions are likely to be encountered during the diversion except when the air operator can demonstrate and justify with an assessment tool and supporting data specific to the aeroplane type for that route of flight, that each element which has an impact on safety has been identified and appropriate mitigating factors have been applied, fuel for the effect of 10 percent of the time during which icing is forecast including the fuel used by engine and wing anti-ice during this period; and
- 5) Any required operation of an auxiliary power unit and/or Ram Air Turbine (RAT).

For an air operator that does not have an approved fuel consumption monitoring program to monitor the aeroplane in-service deterioration of cruise fuel burn performances and includes fuel supply calculations sufficient to compensate for such deterioration, increase the fuel supply by 5 percent.

c) Critical fuel scenario

- 1) Calculation of the critical fuel reserve requires the determination of the failure scenario that is the most operationally critical, considering time and aeroplane configuration. Any failure or combination of failures not shown to be extremely improbable must be considered. The critical fuel reserve is the fuel required, taking into account the items listed in paragraph 3.4.5 b) and:
 - i) To proceed from the most critical point to an ETOPS alternate airport following the occurrence of the most operationally critical event(s); and
 - ii) Upon reaching the ETOPS alternate airport, to descend to 1,500 feet above the airport, hold for 15 minutes, initiate an instrument approach and land.
- 2) For example, if the critical scenario was determined to be the simultaneous failure of one propulsion system and the pressurization system, then the critical fuel reserves would be the fuel required to:
 - i) At the most critical point, cruise at 10,000 feet at the approved one-engine-inoperative cruise speed (fuel consumption may be based on continued cruise above 10,000 feet if the aeroplane has sufficient supplemental oxygen in accordance with applicable regulations); and
 - ii) Upon reaching the ETOPS alternate airport, to descend to 1,500 feet above destination, hold for 15 minutes, initiate an instrument approach and land.

3.4.6 ETOPS ALTERNATE AIRPORTS

- a) ETOPS alternate airports must be chosen in order to make it possible for the aeroplane to reach the ETOPS alternate airport, especially with regard to performance (flight over obstacles) and/or oxygen requirements. A list of ETOPS alternate airports and the ETOPS alternate airport pre and post dispatch weather limits must be published in the air operator's Operations Manual.

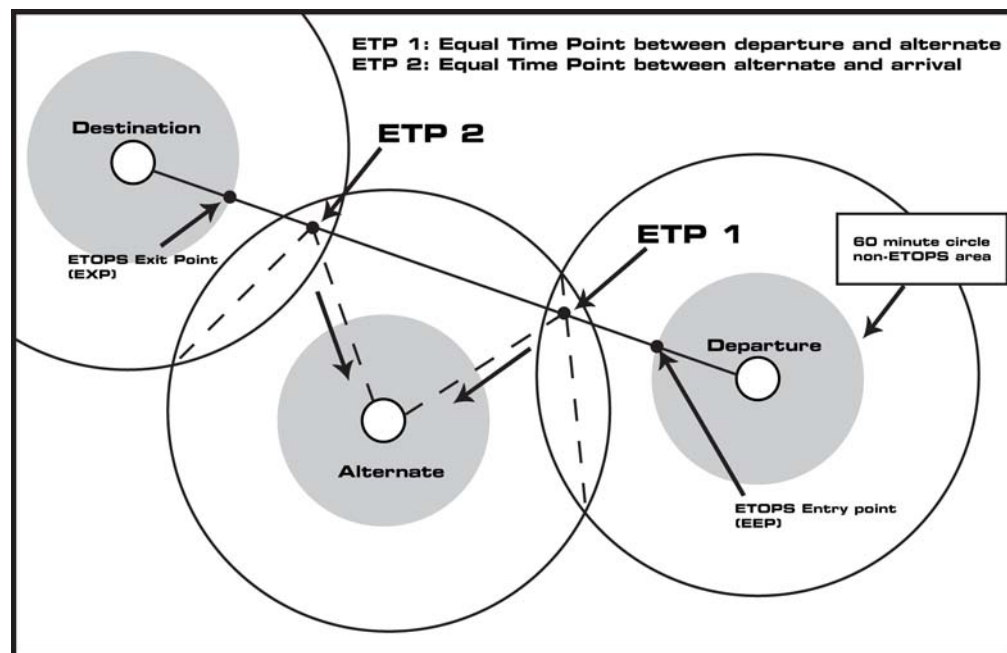
An aeroplane must not be released on an ETOPS flight unless the required take off, destination and alternate airports, including ETOPS alternate airports to be used in the event of a system failure which requires a diversion, are listed in the operational flight plan, (e.g. on board copy of computer flight plan).

All adequate airports that are located within the authorized diversion limits, must be considered when determining the ETOPS alternate airports and the choice and number of ETOPS alternate airports must be made so as to minimize the duration of the diversion;

- b) ETOPS alternates airports are required to be identified, listed and provided to the flight crew with the most up to date information (e.g. airport data, facilities, weather, etc.) as part of the dispatch release for all cases where the planned route of flight contains a point more than 60 minutes flying time at the approved one-engine-inoperative cruise speed from an adequate airport. Since these ETOPS alternates airport serve a different purpose than the destination airport and would normally be used only in the event of an engine failure or the failure of a ETOPS significant system, an airport must not, prior to dispatch, be designated as an ETOPS alternate airport unless the following conditions are met:
- 1) The landing distances required as specified in the Aircraft Flight Manual for the altitude of the airport, for the runway expected to be used, taking into account wind conditions, runway surface conditions, and aeroplane handling characteristics, permit the aeroplane to be stopped within the landing distance available as declared by the airport authorities and computed in accordance with the applicable regulations;
 - 2) The airport services and facilities are available and adequate for the air operator's approved instrument approach procedure(s) and operating minima for the runway expected to be used;

- 3) The latest available forecast weather conditions for a period commencing one hour before the established earliest time of landing and ending one hour after the established latest time of landing at that airport, (Figure 1) are equal to or exceed the authorized weather minima for ETOPS alternate airports as specified in Appendix B of this manual and that the periods between which the forecast must be equal to or exceed the authorized weather minima are identified on the operational flight plan;
- 4) For the same period, the forecast cross wind component for the intended landing runway, including gusts, is less than the maximum permitted cross wind for a single engine landing. Where no single engine demonstrated cross wind value exists, 80% of the all engine demonstrated value is used;
- 5) i) Subject to Clause 3.4.6.a) 5) ii), for ETOPS operation up to 180 minutes, each designated ETOPS alternate airport must meet a minimum Aircraft Rescue and Fire Fighting (ARFF) capability equivalent to that specified by ICAO category 4, or higher and for ETOPS operation beyond 180 minutes, each designated ETOPS alternate airport must meet a minimum Aircraft Rescue and Fire Fighting (ARFF) capability equivalent to that specified by ICAO category 4, or higher provided that the aeroplane remains within the ETOPS authorized diversion time from an adequate airport that meets the minimum capability equivalent to that specified by ICAO category 7, or higher;
- ii) If the equipment and personnel are not immediately available at the airport, the airport may still be listed on the operational flight plan, provided that the ARFF capability is available upon the arrival of the diverting aeroplane and remains at the airport as long as the diverting aeroplane requires their services. A 30-minute response time is adequate provided that the initial notification to respond can be initiated while the diverting aeroplane is enroute and the above conditions are met;

FIGURE 1



Established earliest time of landing: High speed cruise (2 engine operating and high altitude) from ETP 1 to alternate.

Established latest time of landing: Low speed cruise (one engine operating and low altitude) from ETP 2 to alternate.

- iii) Once the flight is dispatched, the flight crew and the flight dispatcher must remain informed of any significant changes at the ETOPS alternates airports and must be updated with the latest weather and airport information of potential adequate airport along the route of flight, that are not listed on the operational flight plan but could be used in case a diversion was initiated; and
 - A) Prior to proceeding beyond the ETOPS Entry Point, the pilot in command and the flight dispatcher must complete a review of the forecast weather of all the ETOPS alternate airports identified on the operational flight plan and must ensure that the forecasted weather is equal to or exceeds the published landing minima for the time period established in subparagraph 3.4.6 b) 3 for the runway and type of instrument approach expected in order to ensure a safe landing at the expected time of use. If the weather forecast does not meet the landing minima, the pilot in command and the flight dispatcher are advised and the flight plan must be amended to add any other ETOPS alternate airport located within the maximum authorized diversion time, that meet the landing minima in order to allow the flight to proceed into the ETOPS area of operation. If unable, the flight must not enter the ETOPS area of operation; and
 - B) Prior to proceeding beyond the ETOPS Entry Point, the pilot in command and the flight dispatcher must complete a review of the conditions established in Paragraph 3.4.6 b) (excluding Subparagraph 3.4.6 b) 3) of the ETOPS alternate airport and ensure that no changes have occurred since the flight has been dispatched. If any conditions are identified which would preclude safe approach and landing, then the pilot in command must be notified and an acceptable ETOPS alternate(s) airport selected where safe approach and landing can be made. If any of the ETOPS alternate airport identified on the operational flight plan is not considered to be adequate at the expected time of use, the operational flight plan must be amended to add another ETOPS alternate airport located within the maximum authorized diversion time, in order to allow the flight to proceed into the ETOPS area of operation. If unable, the flight must not enter the ETOPS area of operation.
- iv) Once the flight has entered the ETOPS area of operation, if the forecast for the ETOPS alternate airport is revised to below the landing limits, or that the ETOPS alternate airport becomes inadequate, the flight may continue at the Pilot in Command's discretion.

FIGURE 2

ETOPS alternate airport	Prior to dispatch	After dispatch and prior to ETOPS entry point	Once enter the ETOPS area of operation
WX	Appendix B	Landing Minima	PIC's discretion
MEL	Applicable	Not applicable	Not applicable
Airport Adequacy	Applicable	Applicable	PIC's discretion

- 6. Flight dispatchers and flight crews must take into consideration the effects of solar flare, cosmic radiation and radio blackout activity that may affect the performance of the flight, when planning or approving the choice of ETOPS alternates airports

3.4.7 AEROPLANE PERFORMANCE DATA

An aeroplane must not be released on an ETOPS flight unless the air operator's Operations Manual contains sufficient performance data to support all phases of any applicable ETOPS operation. The following data must be based on information provided or referenced in the approved Aircraft Flight Manual (AFM):

- 1) Detailed single engine performance data including fuel flow for standard and non-standard atmospheric conditions and as a function of airspeed and power setting, where appropriate, covering:
 - i) Drift down (includes net performance);
 - ii) Cruise altitude coverage including 10,000 feet;
 - iii) Holding;
 - iv) Altitude capability (includes net performance); and
 - v) Missed approach.
- 2) Detailed all-engine operating performance data, including nominal fuel flow data, for standard and non-standard atmospheric conditions and as a function of airspeed and power setting, where appropriate, covering:
 - i) Cruise (altitude coverage including 10,000 feet); and
 - ii) Holding.
- 3) Details of any other conditions relevant to ETOPS operations which can cause significant deterioration of performance, such as ice accretion on the unprotected surfaces of the aeroplanes, Ram Air Turbine, thrust reverser deployment, etc.; and
- 4) The altitudes, airspeeds, thrust settings, and fuel flow used in establishing the ETOPS area of operations for each airframe-engine combination must be used in showing the corresponding terrain and obstruction clearances in accordance with applicable regulations.

3.4.8 NAVIGATION DOCUMENTATION

The necessary navigation documentation including a mean to determine the location of each Equal Time Point and the Critical Point must be provided to the flight crew.

3.5 TRAINING AND EVALUATION PROGRAM

Flight crew member's initial and recurrent ETOPS training requirements are specified in the CASS at Subsection 725.124 (36) Extended Twin-Engine Operations (ETOPS) for Flight Crew Members.

Flight dispatcher's initial and recurrent ETOPS requirements are specified in the CASS at Paragraph 725.124 (21)(t) Extended Twin-Engine Operations (ETOPS) for Flight Dispatchers.

Maintenance personnel's initial, update and additional ETOPS training requirements are specified in section 4.10 of this manual.

3.6 OPERATIONAL LIMITATIONS

3.6.1 AREAS OF OPERATION

Following satisfactory compliance with these criteria, an air operator may be authorized to conduct ETOPS with a particular airframe engine combination within a particular area of operation. The area of operation is limited by the maximum approved diversion time to an adequate airport at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from any point along the proposed route of flight. The area of operation approved must be specified in an Operations Specification.

3.6.2 FLIGHT DISPATCH LIMITATION

Flight dispatch limitation must specify the maximum diversion time from an ETOPS alternate airport for which an air operator can conduct a particular ETOPS operation. The maximum diversion time at the approved one-engine-inoperative cruise speed must not be any greater than the value specified in the Operations Specification.

3.6.3 USE OF STANDARD MAXIMUM DIVERSION TIME

The procedures established must ensure that ETOPS operation is limited to flight plan routes where the approved maximum diversion time to ETOPS alternate airports can be met under standard conditions in still air. Air operators must ensure that:

- 1) A procedure must be established that upon occurrence of an in-flight shutdown (IFSD) of an engine, the pilot in command must, subject to the PIC's authority, promptly initiate a diversion and fly to and land the aeroplane at the nearest suitable* airport, at which a safe landing can be made; and,
- 2) A procedure must be established such that in the event of a single or multiple ETOPS significant system failure, the pilot in command must, subject to the PIC's authority, promptly initiate a diversion procedure and fly to and land at the nearest suitable* airport, at which a safe landing can be made, unless it can be established that no substantial degradation of safety results from continuation of the planned flight.

* Suitable means right or appropriate for the particular situation

3.6.4 PILOT-IN-COMMAND AUTHORITY

Contingency procedures or plans should not be interpreted in any way which prejudice the final authority and responsibility of the Pilot In Command for safe operation of the aeroplane

3.7 OPERATIONS MANUAL

3.7.1 The Company Operations Manual must outline the standard operating procedures applicable to ETOPS operations including, but not limited to, the following:

- a) Minimum altitudes to be flown along planned and diversionary routes as applicable;
- b) Airports authorized for use, including alternates and associated instrument approaches and operating minima;
- c) The information used in determining the critical fuel scenario; and
- d) The minimum equipment list (MEL)

3.8 OPERATIONS SPECIFICATIONS

3.8.1 Aeroplanes must not be operated on ETOPS Operations unless the air operator has complied with all the provisions of this document and the flight is authorized by an Operations Specification.

3.8.2 An Operations Specification for ETOPS Operations must specifically include provisions covering at least the following:

- a) Approved area of operation; and

Note: Flights may be planned to operate through sectors outside of the delimiting arcs, provided the sector crossing is less than 30 track miles;
- b) For each ETOPS approved airframe-engine combination, the maximum diversion time, at the approved one-engine-inoperative cruise speed, that any point on the route may be from an ETOPS alternate airport.

CHAPTER 4 – ETOPS MAINTENANCE AND RELIABILITY REQUIREMENTS

4.1 GENERAL

- 4.1.1** All personnel involved must be made aware of the special nature of ETOPS and have the knowledge, skills and ability to accomplish the requirements of the program. Therefore, the maintenance control system must contain the standards, guidance and direction necessary to support the intended operation of ETOPS aeroplane.
- 4.1.2** The Principal Maintenance Inspector (PMI) having jurisdiction over the air operator must assess over a period of not less than 3 months the maintenance control system as being suitable to support the proposed ETOPS operation before the operational approval for ETOPS can be granted.

4.2 MAINTENANCE CONTROL SYSTEM

- 4.2.1** The maintenance control system required by Subpart VI of Part VII of the Canadian Aviation Regulations that is being considered for ETOPS approval, must be reviewed in conjunction with the aeroplane maintenance schedule, to ensure that it provides an adequate basis for development and inclusion of specific ETOPS maintenance requirements as defined in the Configuration, Maintenance and Procedures (CMP) document for the airframe-engine combination and any applicable Supplemental instructions for continued airworthiness (ICA) that affects ETOPS requirements. The maintenance control system must include procedures to ensure that an aeroplane is not dispatched for an ETOPS flight following maintenance actions that affect multiple similar elements in any system determined to be an ETOPS significant system (e.g. fuel control change on both engines) and ensure that:
 - a) The ETOPS related tasks must be identified on the routine work forms and related instructions;
 - b) The ETOPS related procedures, such as involvement of centralized maintenance control or technical dispatch, must be clearly defined in the maintenance control system, including identification of the management position that is responsible for those procedures;
 - c) An ETOPS service check must be developed and used to verify that the status of the aeroplane and certain significant items are acceptable. Prior to every ETOPS flight (actual or simulated, as applicable), an ETOPS authorized person, accomplishes this check. Authorization may be provided to suitably trained persons to perform this check under the “elementary work” provision of CAR 571 and CAR 605, provided the check is not incorporated into the aeroplane maintenance schedule, and does not include any item that requires a maintenance release; and
 - d) The Quality Assurance program must encompass the review of the aeroplane technical record. This review is to ensure proper MEL procedures, defect rectification and control procedures, deferred items, maintenance checks have been performed properly and system verification procedures are effective.

4.3 MCM REQUIREMENTS FOR ETOPS

- 4.3.1** The Maintenance Control Manual (MCM) must be amended to address ETOPS operations. The manual must include, either directly or by reference to incorporated documents, the requirements described in Chapter 4 of this manual.

- 4.3.2** All ETOPS requirements, including supportive program procedures, duties and responsibilities, must be identified as being related to ETOPS. The amended manual must be submitted to the PMI for approval with sufficient lead-time prior to the scheduled commencement of ETOPS Operations of the particular aeroplane type, model and /or variant. (airframe-engine combination).

4.4 OIL CONSUMPTION

- 4.4.1** The oil consumption program should reflect the type certificate holder's recommendations and be sensitive to oil consumption trends. The dispatch procedures for ETOPS segments are to take into account peak consumption and current running average consumption, including consumption on the immediately preceeding segments. If oil analysis is meaningful to this make and model, it must be included in the program. If the APU is required for ETOPS operation, it must be included in the oil consumption program.

4.5 ENGINE CONDITION AND TREND MONITORING (ECTM)

- 4.5.1** This program must describe the parameters to be monitored, method of data collection and corrective action process. The program should reflect the type certificate holder's instructions and industry practice. This monitoring is used to detect deterioration at an early stage to allow for corrective action before safe operation is affected. The program must ensure that engine limit margins are maintained so that a prolonged single-engine diversion may be conducted without exceeding approved engine limits (i.e. rotor speeds, exhaust gas temperatures) at all approved power levels and expected environmental conditions. Engine margins preserved through this program must also account for the effects of additional engine loading demands (e.g. anti-icing, electrical, etc.) which may be required during the single-engine flight phase associated with the diversion. Monitoring must be on a continual basis. It is necessary to demonstrate that the achieved reliability and performance is sufficiently high.

4.6 VERIFICATION PROGRAM

- 4.6.1** The MCM must describe verification procedures to ensure that the corrective action following an engine in-flight shutdown, an ETOPS significant system failure or adverse trend(s) for any prescribed event(s) is appropriate and effective. This may include a verification flight, or other methods. The description is to include a list of the affected systems and actions, together with the appropriate verification methods. The program must include but is not limited to the type certificate holder's instruction. A clear description of who must initiate verification actions and the section or group responsible for the determination of what action is necessary must be identified in the program. ETOPS significant systems or conditions requiring verification actions must be described in the MCM.

- 4.6.2** The MCM must also describe verification procedures to be applied following maintenance actions that affect multiple similar elements in any system determined to be an ETOPS significant system.

4.7 RELIABILITY PROGRAM

- 4.7.1** A reliability program that focuses on ETOPS significant systems must be established. If a reliability program already exists, it must be supplemented as applicable to take account of ETOPS. The program must be designed with early identification and prevention of ETOPS related significant event when operating ETOPS as the primary goal as well as ensuring that the minimum ETOPS reliability levels are maintained. The program must be event-oriented and incorporate reporting procedures for significant events and trends detrimental to ETOPS flights. This information must be readily available for use by the air operator and the PMI to help establish that the reliability level is adequate, and to assess the air operator's competence and capability to safely continue ETOPS Operations. An ETOPS reporting program must be established which ensures that the PMI is notified at least monthly, on the previous month's activities or more often if adverse trends reportable through this program are identified.

4.7.2 Procedures for the roll back of the ETOPS diversion time must be established and implemented if;

- a) A significant event is identified on any flight, including non ETOPS flights, of the air operator's ETOPS approved aeroplane type affected; or
- b) An adverse trend is identified through the reliability program.

The Maintenance Manager must have the authority to initiate roll back of the approved ETOPS diversion time.

4.7.3 Where reliability data indicate that the propulsion system "target criteria" per Appendix A of this document, Figure 1, are no longer being met, the PMI must be notified of the corrective measures taken. Where the "minimum criteria" are no longer being met, the air operator must roll back the ETOPS diversion time to that specified in Appendix A for the particular IFSD rate noted. An IFSD could be discounted pursuant to conditions such as:

- a) The IFSD is not the result of any action or inaction from the part of the air operator;
- b) The IFSD is not the result of any action or inaction from the part of the maintenance provider; or
- c) The IFSD is the result of an operational incident such as a bird strike at low altitude.

When discounting of IFSD, the air operator, PMI and POI must have consensus. If required, the PMI is to consult with the Aircraft Certification Engineering Division for interpretation and/or guidance on a case-by-case basis.

4.7.4 Failure of an air operator to roll back the maximum diversion time when required constitutes grounds for removal of ETOPS authority.

4.7.5 The following events must be included in the reporting program:

- 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 ETOPS significant systems

4.7.6 THE REPORT MUST 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; and
- f) Corrective action.

4.8 CONTRACTED MAINTENANCE AND RELIABILITY

4.8.1 Air operators who contract any part of their maintenance control system and/or reliability programs, necessary to support their ETOPS approval, to any other organization, remain responsible for ensuring that all elements of this program are addressed and continue to meet the applicable requirements.

- 4.8.2** For those air operators whose ETOPS approval is based on reliability levels established by other organizations, Transport Canada does not consider ETOPS approval privileges beyond those granted by the other organization's Civil Aviation Authority.

4.9 PROPULSION SYSTEM MONITORING

- 4.9.1** The assessment of propulsion systems reliability for the ETOPS fleet must be made available to the PMI (with supporting data) in accordance with an agreed upon frequency, to ensure that the approved maintenance control system continues to maintain a level of reliability necessary for ETOPS operation.
- 4.9.2** The assessment must include, as a minimum, engine hours flown in the period, in-flight shut down rate for all causes and engine removal rate, both on a 12 month moving average basis. Where the combined ETOPS fleet is part of a larger fleet of the same aircraft/engine combination, data from the air operator's total fleet is acceptable. However, the reporting requirements of Section 4.7 of this Chapter must still be observed for the ETOPS fleet.
- 4.9.3** Any adverse trend requires an immediate evaluation to be accomplished. TCCA must be advised of the result of the evaluation. The evaluation may result in corrective action or operational restrictions being applied.

Note: Where statistical assessment alone may not be applicable, e.g. when the fleet size is small, the air operator's performance is reviewed on a case-by-case basis. The review includes such items as actual data populating the air operator's reliability program and being compared, where possible, to global fleet data on the power plants and related ETOPS maintenance significant systems, as well as air operator events, including IFSD's and loss of thrust, with the results of investigation into the cause(s) of the events.

4.10 TECHNICAL TRAINING

- 4.10.1** The technical training must include an element that addresses the special nature of ETOPS. This training must be included as an integral part of the air operator's maintenance program. The goal of this element of the program is to ensure that all personnel who are assigned ETOPS responsibilities (including technical dispatch, parts control or any other ETOPS related function) are provided with the necessary training so that ETOPS tasks are properly accomplished. Qualified personnel are those that have completed the ETOPS training program and have satisfactorily performed ETOPS tasks under supervision, within the framework of the approved procedures for Personnel Authorization.

4.11 ETOPS PARTS CONTROL

- 4.11.1** The parts control program must include procedures to ensure that appropriate parts are installed on ETOPS aircraft. The program must include means to verify that parts obtained through borrowing or pooling arrangements, conform to the applicable ETOPS configuration for the aeroplane concerned.

APPENDIX A – PROPULSION SYSTEM RELIABILITY ASSESSMENT

A.1 GENERAL

A.1.1 TYPE DESIGN APPROVAL

To establish if a particular airframe engine combination has satisfied the propulsion system reliability criteria for ETOPS, a thorough assessment must be conducted by specialists of the responsible airworthiness authority for airframe propulsion system design utilizing all the pertinent engine and airframe propulsion system data and information available (includes the APU, if required).

Transport Canada Civil Aviation (TCCA) reviews these findings as part of the aeroplane type design approval activity.

A.1.2 OPERATIONAL APPROVAL

The intent of the operational approval is to establish if an air operator has demonstrated the capability of ensuring propulsion system reliability targets have been met and continue to be met.

A.2 CONCEPTS AND CRITERIA

No single parameter by itself, without other data/information, can adequately qualify reliability. There are a number of variables, maintenance and operating statistics and general information about the operational experience of a particular power unit, which characterize propulsion system reliability. Engineering judgment must then be utilized to determine the adequacy and applicability of this data and information to ETOPS and to determine the suitability of the aeroplane for ETOPS. As an aid in making this judgment, statistical analysis is used to help determine that the desired level of reliability is obtained.

The evidence must be such that it can be shown with high confidence that the risk of total thrust loss or loss to an extent that precludes continued safe flight, is acceptably low, i.e., at an appropriate level less than between 10^{-8} and 10^{-9} per hour during the relevant portion of the cruise.

A.3 ASSESSMENT

To assess adequately the propulsion system reliability for ETOPS type design and operational approval, certain world fleet data and information are required. The Regulatory specialists maximize the use of existing sources and kinds of data generally available but additional data may be required in certain cases.

A.3.1 DATA REQUIREMENTS

A3.1.1 Type Design Approval – World fleet data and information are necessary to adequately assess propulsion system reliability for ETOPS. This data must include:

- 1) A list of all engine shutdown events both ground and in-flight for all causes (excluding normal training events) including flameout. The list must provide the following for each event: data, airline, aeroplane and engine identification (model and serial number), power unit configuration and modification history, engine position, symptoms leading up to the event, phase of flight or ground operation, weather/environmental conditions and reason for shutdown;
- 2) A list of all occurrences where achieved thrust was below the intended level, for whatever reason: The list must provide the above detailed information;
- 3) Data concerning total engine hours and aeroplane cycles (if known, include engine hour distribution, e.g., percent of world fleet of engines at 1,000 hours, 2,000 hours, etc.);
- 4) Data listing mean time between failure of the propulsion system and associated components that affect reliability (unscheduled removals);

- 5) The amount and frequency of using reduced/de-rated thrust (if detailed data is not available, a representative sampling may be sufficient); and
- 6) Additional data as specified by the specialist group.

A.3.1.2 Operational Approval – Data requirements for ETOPS Type Design Approval Paragraph A.3.1.1) limited to air operator fleet experience and any experience claimed as compensatory experience (see Engineering Assessment Subsection A.3.3).

A.3.2 EXPERIENCE

A.3.2.1 Type Design – In support of applications for ETOPS type approval, data must be provided from various sources to ensure completeness, i.e., engine manufacturer, air operator and aeroplane manufacturer.

To provide a reasonable indication of reliability trends and significant problem areas, an accumulation of at least 150,000 engine hours is normally required in the world fleet before the assessment process can produce meaningful results. This number of hours may be reduced if adequate compensating factors are established which give a reasonable equivalent data base.

Once an assessment has been completed and the specialist groups have documented their findings, the Director, Aircraft Certification, declares whether or not the current propulsion system reliability of a particular airframe engine combination satisfies the relevant criteria of this document. TCCA specifies items required to qualify the propulsion system suitable for ETOPS, such as the recommended propulsion system type design configuration, operating conditions, maintenance requirements and limitations.

A.3.2.2 Air operator – Operational experience is required to ensure the air operator continues to maintain and operate the particular airframe-engine combination at an acceptable level of reliability. The assessment of an air operator's suitability to be granted an ETOPS approval is routinely made after a minimum amount of operating experience. Operational experience requirements may be reduced if adequate compensatory experience factors exist (see Appendix C of this document). The accepted basic experience requirement is defined in Chapter 3 of this document.

A.3.3 ENGINEERING ASSESSMENT

A.3.3.1 An analysis, on a case by case basis, of all significant failures, defects and malfunctions experienced in service (or during testing) for the airframe engine combination must be addressed. Significant failures are principally those causing or resulting in in-flight shutdown or flameout of an engine but may also include unusual ground failures and/or unscheduled removal of engines from the aeroplane. In making the assessment, consideration is given to the following:

- a) The type of power unit, previous experience, whether the power unit is new or a derivative of an existing model and the engine operating rating limit to be used with one engine shutdown;
- b) The trends in cumulative and six and twelve months rolling average, updated quarterly, of in-flight shutdown rates versus propulsion system flight hours and cycles;
- c) The effect of corrective modifications, maintenance, etc., on future reliability of the propulsion system;
- d) Maintenance actions recommended and performed and its effect on engine and APU failure rates;
- e) The accumulation of operational experience which covers the range of environmental conditions likely to be encountered; and
- f) Intended maximum flight duration, maximum diversion and mean diversion time used in ETOPS.

A.3.3.2 Type Design – An assessment of the corrective actions planned or taken for each problem identified with the objective of verifying that the action is sufficient to correct the deficiency.

When each identified significant deficiency has a corresponding TCCA accepted corrective action and when all corrective actions are satisfactorily incorporated and verified, TCCA determines that an acceptable level of reliability can be achieved. Statistical corroboration is also utilized.

Any certification inspections and tests that may be necessary to approve these corrective actions is the responsibility of the appropriate Design Approval Authority. The required corrective action and modifications are included in the type design standard necessary for final type approval of the aeroplane for ETOPS.

A.3.3.3 Operations – TCCA recognizes that a number of potential countable events (e.g. IFSDs, flameouts, uncommanded thrust reductions, etc.) are not ETOPS relevant or action has been taken to preclude further occurrences. An air operator may request, through the PMI, POI Aircraft Certification Engineering Division, that such an event be discounted so that the propulsion system reliability objective is not affected. Any configuration, maintenance or procedural change to satisfy the event discounting become part of the ETOPS CMP criteria. (Credit for optional equipment, e.g. ACARS, must be reviewed against MEL criteria) Refer to Subsection 4.7.3 for additional information on discounting of IFSDs.

A.4 PROPULSION SYSTEM RELIABILITY OBJECTIVE

A.4.1 TYPE DESIGN

A determination is made that the type design of the propulsion system achieves the desired level of reliability. TCCA determines if the probability of total/unacceptable thrust loss due to design related and/or independent causes meet the criteria of this section.

A.4.2 OPERATIONS

A.4.2.1 A determination is made of the propulsion system's ability to achieve the desired level of operational reliability in ETOPS. TCCA determines if the probability of total/unacceptable thrust loss for all independent causes meets the criteria of this section.

A.4.2.2 The propulsion system reliability objective ensures that the propulsion system achieves at least the minimum reliability criteria required of other critical aeroplane systems, i.e., navigation, flight control, communications, etc.

Considering the complexity of the entire powerplant system, the approach to determine the reliability has been to use in service data. This data therefore, not only considers design related failures (Airworthiness Manual Section 525.1309 approach), but also includes maintenance and operational effects on the failure rates.

The events to be considered are to include those occurring from the beginning of the take-off roll to the end of the landing phase, though items confirmed as not ETOPS significant are discounted. Failures considered are engine in-flight shutdowns (IFSD) and any other significant power loss or loss of engine control. The reliability objective used by TCCA relates diversion time to the probability of a loss of thrust which precludes continued safe flight.

The target is expressed by the following formula:

$$(10^9)(Pe^2)(t) \leq 1$$

where

Pe = probability of an engine failure (per hour)

t = diversion time (hours)

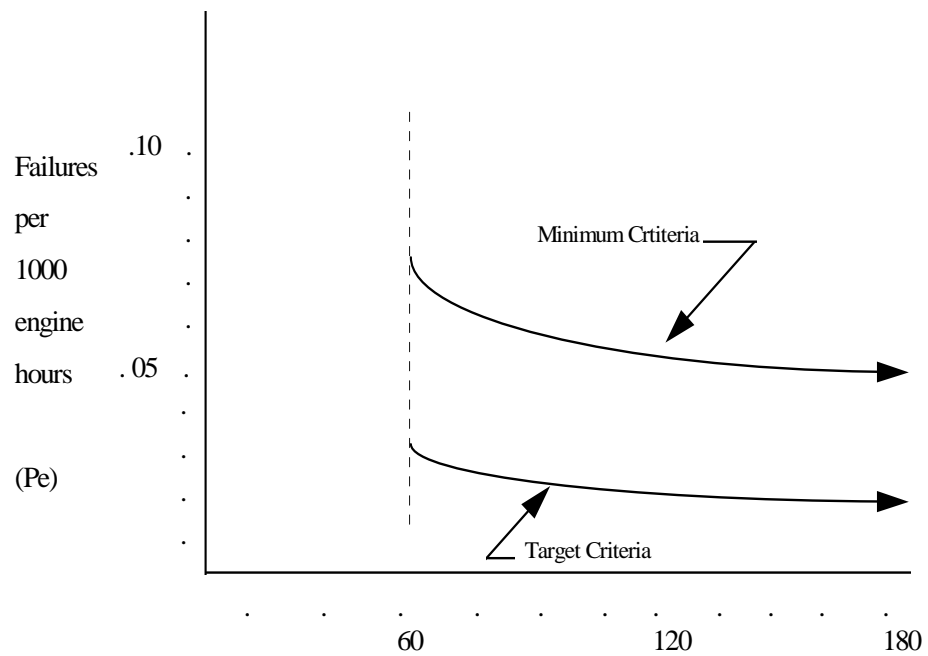
(10⁹) represents the life of an entire aeroplane fleet (hours)

TCCA believes some tolerance is required to account for verified corrective actions and precautionary shutdowns and also to provide for the expected variance over time in propulsion system reliability statistics. Reported occurrences beyond the tolerance are grounds for withdrawal of ETOPS approval, or reduction in allowed diversion time. The maximum criteria is defined by the following formula:

$$(.25)(109)(Pe^2)(t) \leq 1$$

FIGURE 1

Propulsion System Reliability Objective



DIVERSION TIME (MINUTES) (T)

RELIABILITY TABLE (ENGINE FAILURES PER 1000 HOURS)

Diversion Time (t)	Target Criteria	Minimum Criteria
60 minutes	.032	.063
75 minutes	.028	.056
90 minutes	.026	.052
120 minutes	.022	.044
138 minutes	.021	.042
180 minutes	.018	.036

APPENDIX B – ETOPS ALTERNATE AIRPORT

B.1 GENERAL

One of the distinguishing features of ETOPS is the concept of an ETOPS alternate airport being available to which an aeroplane can divert after a single or combination of failures which require a diversion. Whereas most two-engine aeroplanes operate in an environment where there is usually a choice of diversion airports available, the ETOPS aeroplane may have only one alternate within a range dictated by the endurance of a particular airframe system (e.g. cargo fire suppressant), or by the approved maximum diversion time for that route.

It is, therefore, important that any airports designated as an ETOPS alternate airport have the capabilities, services and facilities to safely support that particular aeroplane and that the weather conditions at the time of arrival provide a high assurance that adequate visual references are available upon arrival at decision height (DH) or minimum descent altitude (MDA) and that the surface conditions are within acceptable limits to permit the approach and landing to be safely completed with an engine and/or systems inoperative.

B.2 ADEQUATE AIRPORT

As with all other operations, an air operator desiring any route approval is required to show that it is able to satisfactorily conduct operations between each required airport over that route or route segment. Air operators are required to show that the facilities and services specified are available for their use and adequate for the proposed operation. For the purpose of this manual, in addition to meeting these criteria, those airports, which meet TCCA standards or ICAO Annex 14 and are determined to be useable by that particular aeroplane, are to be accepted as adequate airports.

B.3 ETOPS ALTERNATE AIRPORT

For the purposes of this document in order for an airport to be considered as an ETOPS alternate airport, it must have the capabilities, services and facilities necessary to be designated as an adequate airport and have weather conditions and field conditions at the time of the particular operation which provide a high assurance that an approach and landing can be safely completed with an engine and/or systems inoperative, in the event that a diversion to an ETOPS alternate airport becomes necessary. For planning purposes only, the ETOPS alternate airport weather minima are higher than the weather minima required to initiate an instrument approach.

B.4 ETOPS ALTERNATE AIRPORT WEATHER MINIMA

The following are established for flight planning and dispatch purposes in ETOPS operations:

FACILITIES AVAILABLE AT ETOPS ALTERNATE AIRPORT	CEILING	VISIBILITY
2 or more useable precision approaches each providing straight-in minima to separate suitable runways.(Two separate landing surfaces)	400 feet, or 200 feet above the lowest useable HAT, whichever is higher.	1 s.m., or 1/2 s.m. more than the lowest useable visibility limit, whichever is greater.
1 useable precision approach.	600 feet, or 300 feet above the lowest authorized HAT/HAA, whichever is higher.	2 s.m., or 1 s.m more than the lowest published landing visibility, whichever is greater.
1 useable non-precision approach.	800 feet, or 300 feet above the lowest authorized HAT/HAA, whichever is higher.	2 s.m., or 1 s.m more than the lowest published landing visibility, whichever is greater.

See the Aeronautical Information Manual (AIM) TP14371 GEN section for conversion factors/tables.

A particular airport may be considered an ETOPS alternate airport for flight planning and dispatch purposes for ETOPS operations if it meets the criteria of Section B.3 of this Appendix and has one of the following combinations of instrument approach capabilities and ETOPS alternate airport weather minima at the time of the particular operation:

Note: Weather forecasts that contain the term BECMG, TEMPO or PROB may be used to determine the weather suitability of an airport as an ETOPS alternate provided that.

- Where the conditions are forecast to improve, the forecast BECMG condition must be considered to be applicable as of the end of the BECMG time period, and these conditions must not be below the published alternate minima requirements for that aerodrome;
- Where the conditions are forecast to deteriorate, the forecast BECMG condition must be considered to be applicable as of the start of the BECMG time period, and these conditions must not be below the published alternate minima requirements for that aerodrome;
- The forecast TEMPO condition must not be below the published alternate minima requirements for that aerodrome; and
- The forecast PROB condition must not be below the appropriate landing minima for that aerodrome. Where a condition is forecast as “PROB”, provided the probability per cent factor is less than 40 per cent, it is not limiting. However the Pilot-In-Command and flight dispatcher are to exercise good aviation judgment in assessing the overall “PROB” conditions.

For the purpose of ETOPS, a flight is deemed to be commenced/dispatched after brake release for take-off. Thus, during the planning stage and prior to the aeroplane being dispatched, the ETOPS alternate airport must meet the criteria of Section B.4 of this Appendix. Once the flight is dispatched, and prior to the ETOPS entry point, the ETOPS alternate airport must meet the published landing minimum for the intended runway and instrument approach to be used in the event of a diversion. Once the flight has entered the ETOPS area of operation, if the forecast for the ETOPS alternate airport is revised to below the landing limits, or that the ETOPS alternate airport becomes inadequate, the flight may continue at the Pilot in Command’s discretion.

APPENDIX C – ACCELERATED ETOPS OPERATIONAL APPROVAL

C.1 GENERAL

This Appendix is a means to identify factors, which TCCA may consider to allow a reduction or substitution of in-service experience requirements on a case by case basis, prior to granting Accelerated ETOPS Operational Approval for a specific airframe-engine combination up to and including 180 minutes ETOPS.

In addition to the requirements of this Appendix, an air operator wishing to be considered for an accelerated ETOPS approval up to and including 180 minutes for a specific airframe-engine combination, must either conduct actual ETOPS operation at 120 minutes for a minimum period of at least 3 months or comply with the condition of a simulated ETOPS program as defined in Appendix D. On a case-by-case basis, an air operator already operating at 180 minutes with a different airframe-engine combination may obtain 180 minutes approval in less than 3 months provided that all the conditions of this Appendix are met.

An excellent propulsion related service safety record for two-engine aeroplanes has been maintained since the introduction of ETOPS. Current data indicates that the ETOPS process benefits are achievable without extensive in-service experience. Therefore, reduction or elimination of in-service experience requirements may be possible when the air operator demonstrates that adequate and validated ETOPS processes are in place.

The Accelerated ETOPS Operational Approval Program with reduced in-service experience does not imply that a reduction of existing levels of safety are tolerated but rather acknowledges that an air operator may satisfy the objectives of this document by an equivalent means when considering demonstrated operational capability.

An air operator may be permitted to start ETOPS operations under the conditions of this Appendix when it has established and demonstrated that those processes necessary for successful ETOPS operations are in place and are considered to be reliable. It must be emphasized that failure to meet the established criteria, milestones or reliability levels may result in the losing of the Accelerated ETOPS Operational Approval.

C.2 POLICY

C.2.1 ETOPS PROCESS

The airframe-engine combination for which the air operator is seeking Accelerated ETOPS Operational Approval must be ETOPS Type Design approved. It must be demonstrated that there is a program in place to address the process elements identified in this section.

The following are the required ETOPS process elements:

- a) Airframe-engine compliance to Type Design Build Standard (CMP)
- b) Compliance with the ETOPS Maintenance and reliability requirements as described in Chapter 4 of this manual, requiring the following proven ETOPS programs to be in place:
 - 1) Fully developed Maintenance Control System, as required by Section 4.2 of this manual;
 - 2) Amended Maintenance Control Manual (MCM) as required by Section 4.3 of this manual;
 - 3) Oil consumption monitoring as required in Section 4.4 of this manual;
 - 4) Engine condition and trend monitoring (ECTM) as required in Section 4.5 of this manual;
 - 5) Verification as required by Section 4.6 of this manual;
 - 6) Reliability Program as required by Section 4.7 of this manual;

- 7) An established propulsion system monitoring program, that results in a high degree of confidence that the propulsion system reliability appropriate to the ETOPS diversion time is maintained as per Section 4.9 of this manual;
 - 8) Initial, update and additional training as well as authorization for all personnel involved in ETOPS operations;
 - 9) ETOPS parts control as per Section 4.11 of this manual; and
 - 10) Aeroplane defect control system.
- c) Compliance with the Flight Operations Program for ETOPS as described in Chapter 3 of this manual, which must address:
- 1) Flight planning and dispatch programs, including initial and annual recurrent ETOPS training for flight dispatcher;
 - 2) Availability of meteorological information;
 - 3) Minimum Equipment List (MEL) considering ETOPS operation; and
 - 4) ETOPS initial and recurrent training and checking program for each flight crew member.
- d) Documentation of the following elements:
- 1) Technology new to the air operator and significant differences in ETOPS significant systems between the aeroplane currently operated and the aeroplane for which the air operator is seeking Accelerated ETOPS Operational Approval;
 - 2) The plan to train each flight crew member, flight dispatcher and maintenance personnel to the differences identified in Paragraph C.2.1 d) 1. above;
 - 3) The plan to use proven or manufacturer validated Training, Maintenance & Operations Manual procedures relevant to ETOPS for the aeroplane for which the air operator is seeking accelerated ETOPS approval;
 - 4) Changes to any previously proven or manufacturer validated Training, Maintenance or Operations Manual procedures described above. Depending on the nature of the changes, a plan for validating such changes, may be required;
 - 5) Details of any ETOPS program support from the aeroplane type certificate holder, engine type certificate holder, other air operators or any other outside agency; and
 - 6) The control procedures when maintenance or flight dispatch support is provided by an outside party as described above.

C.2.2 APPLICATION

An “Accelerated ETOPS Operational Approval Plan” must be submitted to TCCA a minimum of 6 months before the proposed start of operations. This period gives an opportunity to incorporate any refinements that may be required to achieve an Accelerated ETOPS Operational Approval.

The application for Accelerated ETOPS Operational Approval must:

- a) Define proposed routes and necessary diversion times required to support the applicable routes;
- b) Define processes and resources allocated to initiate and sustain ETOPS;
- c) Identify the plan for establishing and maintaining ETOPS build standard compliance;
- d) Document plan for compliance with items outlined in Section C.2.1; and
- e) Define Review Gates (a Review Gate is a milestone tracking plan to allow to define the tasks and timing for the necessary tasks to be accomplished); items for which TCCA visibility or approval is sought must be included in the Review Gates. These milestone tasks must be completed during the approval process although the timing may vary.

C.2.3 OPERATIONAL APPROVALS

Operational approvals are to be considered on individual merit and capability (case-by-case basis). Accelerated ETOPS Operational Approval is not guaranteed and air operators are encouraged to await approval prior to planning revenue ETOPS operations.

Accelerated ETOPS Operational approvals which are granted with reduced in-service experience are to be limited to those areas agreed by TCCA contained within the Accelerated ETOPS Operational Approval Plan. Concurrence from TCCA is required if the air operator wishes to add or expand the request.

Air operators may be eligible for Accelerated ETOPS Operational Approval up to the Type Design Approval limit.

C.2.4 PROCESS VALIDATION

All the process elements identified in Section C.2.1 must be proven prior to an Accelerated ETOPS Operational Approval. In order for a process to be considered proven, it first must be defined. Thus, the various elements of the process must be clearly demonstrated. Role and responsibilities of the personnel who are managing this process must be defined including the training requirements.

It must be demonstrated that the established process is in place and functions as intended. This may be accomplished by thorough documentation and analysis, or by demonstration on an aeroplane (simulation) to confirm that the process works and consistently provides the intended results. There must also be a system in place to ensure that there is proper feedback in the event there is a need to revise the process.

Any simulation flights must not be initiated prior to:

- a) The completion of the applicable training of flight crews, maintenance personnel, dispatch personnel;
- b) The approval of the ETOPS maintenance control systems;
- c) The reliability program being in place and operating; and
- d) The aeroplane being configured for ETOPS.

Simulation is a coordinated operation between flight operation and maintenance of all the elements of an air operator's ETOPS process in a non-ETOPS environment.

An air operator who is currently operating ETOPS on different airframe and/or engine combination may be able to demonstrate that it has a proven process in place and may only require minimal validation. However, it may be necessary to demonstrate that there are means in place to assure an equivalent results on the aeroplane for which an accelerated ETOPS approval is requested.

Given that air operator's accelerated ETOPS approval is considered for its individual merit and capability on a case-by-case basis at the time of the application, it is important to note that the following elements, although beneficial in justifying a reduction in the validation requirements of the ETOPS process, do not automatically justify that the process identified in Section C.2.1 is a proven one:

- a) The air operator's experience with other similar airframes and/or engines;
- b) The air operator's previous ETOPS experience;
- c) The air operator's long range, over-water operational experience; and
- d) The air operator's flight crew, maintenance and flight dispatch personnel experience with ETOPS.

A process may be validated initially by demonstration on a different aeroplane type or airframe-engine combination than the airframe-engine combination intended to be used in the Accelerated ETOPS operation. It is then necessary to demonstrate that means are in place to assure equivalent results occur on the aeroplane being proposed for Accelerated ETOPS Operational Approval.

Any validation program must address the following:

- a) Assurance that the validation program does not adversely impact actual safety of operations especially during periods of abnormal, emergency, or high cockpit workload operations. It must be emphasized that during these abnormal situations the validation exercise may be terminated;
- b) A means to monitor and report performance with respect to accomplishment of tasks associated with ETOPS process elements. Any changes to ETOPS maintenance and operational process elements must be defined;
- c) Assurance that the validation program provides sufficient frequency and operational exposure to validate maintenance and operational support systems;
- d) Prior to the start of the process validation program, the following information is submitted to the Principal Operating Inspector (POI):
 - i) Validation period, including start dates and proposed completion dates;
 - ii) Definition of the aeroplane, manufacturer and serial number and model of the airframe and engine;
 - iii) Description of the area of operation proposed for the validation and actual ETOPS operation; and
 - iv) Definition for the designated ETOPS routes that should be of a duration necessary to ensure process validation; and
- e) Compilations of the result of the ETOPS process validation that :
 - i) Documents how each element of the ETOPS process was utilized during the validation;
 - ii) Documents any short comings with the process elements and measures in place to correct short comings;
 - iii) Documents any changes to the ETOPS processes that were required after an in-flight shutdown (IFSD), unscheduled engine removals, or any other significant operational events; and
 - iv) Provides periodic process validation reports to their POI. This may be addressed during the review gates.

C.2.5 ACCELERATED ETOPS SURVEILLANCE

Deficiencies associated with engineering and maintenance control systems, flight dispatch or flight crew performance may result in the rejection of or amendment to, the claimed credit for reduced in-service experience.

Therefore, an accelerated program leading to an ETOPS Operational Approval is considered feasible so long as the air operators retain commitment to the standards which are contained in their ETOPS Operational Approval Plan and associated programs. During the first year of operation close monitoring must be exercised.

C.2.6 MINIMUM REQUIREMENTS

- 1) The Accelerated ETOPS Operational Approval allows for a reduction of in-service experience, based on the degree of compliance with the existing air operator's ETOPS program, which can be validated with supporting documentation. The typical operational experience requirements for a given airframe-engine combination is:
 - a) Minimal or no in service experience for 90 minutes approval;
 - b) Minimal or no in service experience for 120 minutes approval; and
 - c) 3 months 120 minutes ETOPS experience for 180 minutes approval.

On a case-by-case basis, the in-service experience requirements for an accelerated ETOPS approval specified in this paragraph may be further reduced provided that the air operator can successfully demonstrate to the satisfaction of the Principal Operation Inspector (POI) and Principal Maintenance Inspector (PMI) that all of the elements of their ETOPS process for the applicable airframe-engine combination are proven and function as intended.

This may either be accomplished via:

- a) The air operator conducting a simulated ETOPS program as per the requirements of Appendix D of this document; or
 - b) Supporting documentation and demonstration that the elements of a ETOPS process that has been validated for another airframe-engine combination and could be applicable to the new airframe-engine combination would function to an equivalent level of safety on the new airframe-engine combination; and
 - c) Those elements of the ETOPS process that are unable to be proven until the new airframe-engine combination enters service, must be validated prior to the approval of the requested authority.
- 2) All in-service experience requirements noted above assume acceptable performance. Air operator ETOPS program difficulties may require additional in-service experience and/or removal of the eligibility for Accelerated ETOPS Operational Approval.

Intentionally left blank

APPENDIX D – SIMULATED ETOPS PROGRAM

D.1 GENERAL

This Appendix provides the guidance for an air operator to substitute the actual in-service experience at 120 minutes ETOPS operation required to obtain 180 minutes ETOPS approval. It establishes the conditions under which TCCA may authorize an air operator to gain in-service experience through a simulation/demonstration program as a pre-requisite for applying for 180 minutes ETOPS authority. The intent is to permit an air operator who does not have the capability to demonstrate ETOPS operation due to route structure to develop and validate an ETOPS program leading to 180-minutes approval.

The objective of the ETOPS simulation/demonstration is to provide the air operator with an acceptable level of experience to demonstrate its capability to safely operate with a maximum diversion time of 180 minutes.

D.2 IN SERVICE EXPERIENCE REQUIREMENTS

An air operator who wishes to obtain 180 minutes authority through a simulation/demonstration program is to have at least 12 consecutive months of operational in-service experience with the specified airframe-engine combination before the start of a simulated ETOPS flight.

D.3 APPLICATION

A request to TCCA must be submitted for approval to conduct a simulated and demonstrated ETOPS program, at least 60 days prior to the intended start of the simulated ETOPS flights. The request must address the criteria contained in this manual for 180 minutes ETOPS programs. The application must also contain information on the proposed simulated operation, the proposed demonstration flights and the proposed actual operation. There may be certain items related to 180 minutes and actual operations, which the air operator will not be prepared to address initially. If applicable, these items must be identified to the POI and PMI and addressed during the final application for 180 minutes authority. The application to conduct simulated or demonstrated ETOPS must include:

- a) The proposed simulation and demonstration periods (start and end dates);
- b) A list of aeroplanes to be used in the simulation and demonstration, including aeroplane registration, manufacturer and serial number and model of the airframes and engines;
- c) A description of the areas of operation proposed for simulated, demonstrated and actual operations;
- d) A list of designated ETOPS simulation routes, of sufficient duration to provide adequate simulation and usually the air operator's longest routes, and demonstration routes required to be the proposed routes;
- e) A description of the air operator's relevant ETOPS in-service experience with other airframe-engine combinations and/or relevant non ETOPS in-service experience with the airframe-engine combination to be used in the simulation, including records of in-flight shutdowns, unscheduled engine removals, and any events that could be considered as ETOPS significant events;
- f) A description of aeroplane configuration with respect to the applicable CMP document at the start of simulation, including a schedule of compliance for items not yet incorporated or a statement of the date that full compliance is expected;

Note: items requiring incorporation are discussed in Subsection D.7. c)

- g) A minimum number of ETOPS simulation and demonstration segments performed;
- h) A supplemental ETOPS maintenance and reliability requirements of Chapter 4 of this manual;
- i) A plan to ensure that maintenance personnel, at proposed departure and destination airports in the actual area of operation, are qualified in accordance with Chapter 4 and the CARs;
- j) Policy guidance to personnel involved in the program in regards to flight safety as stated in Section D.5 of this appendix;

- k) Operations requirements that meet the criteria of this manual and the appendices;
- l) A Gate and Milestone tracking plan to allow for the orderly tracking and documentation of specific requirements of the ETOPS; and
- m) Any other items relevant to the applicant's ETOPS program requested by the POI and/or PMI;

D.4 AUTHORITY

Authority to conduct 180 minutes ETOPS through a simulated program is granted via an Operation Specification and is initially limited to the areas of operation in which the air operator has already demonstrated capability. New areas of operation are authorized once the air operator's 180 minutes ETOPS and overall in-service experience record is proven.

D.5 FLIGHT SAFETY

While operating in a simulated ETOPS program, it must be clearly demonstrated that the impact of such a program, on flight safety in actual operation, has been considered. When applying to conduct a simulated ETOPS program, it must be clearly stated that the ETOPS simulation must be terminated immediately during any abnormal or emergency situation.

D.6 SIMULATION/DEMONSTRATION PROGRAM REQUIREMENTS

The following is a list of basic elements which must be considered for a simulation/demonstration program. These elements must be addressed both in the initial request and during operations conducted under the program. The elements are:

- a) A fully developed and approved Maintenance Control System;
- b) An approved airframe, system and engine reliability monitoring and reporting systems;
- c) An approved flight planning and dispatch program;
- d) An approved initial and recurrent training and checking program for flight crew and flight dispatchers;
- e) An approved initial training, qualifications and authorization program for ETOPS maintenance personnel;
- f) A simulation scenario of sufficient frequency and operational exposure to demonstrate the application and response of maintenance and operational support systems;
- g) A means to monitor and report ongoing ETOPS performance results during the period of the simulation to provide validation or, as necessary, recommended changes to ETOPS maintenance and operational support systems; and
- h) resource allocation and decision making process which demonstrates commitment by management and all personnel involved in ETOPS maintenance and operational systems support.

D.7 CONCEPT FOR SIMULATION

The simulation is intended to provide for accumulation of in-service experience, which is equivalent to the actual conduct of ETOPS operation. The following must be addressed:

- a) Identification of simulated areas of operation and alternates that are proposed to be used to meet the dispatch limitations for an ETOPS alternate airport;
- b) A plan to conduct simulated ETOPS with the specified airframe engine for at least 12 consecutive months. The sample size should consist of approximately 1000 separate flights. These operations should be conducted on flights, which contain approximately 3 hours of cruise flight. The number of operations and months of in-service experience may be increased or decreased following a review by the POI on a case-by-case basis considering:
 - 1) Experience with similar technology airframe-engine combinations in conducting ETOPS; (i.e., 757/767, A 310 or A330);
 - 2) Experience with the specified airframe engine combination;
 - 3) Experience with non-ETOPS aeroplane in international over water operations;
 - 4) The record of the airframe engine combination in ETOPS with other air operators; and
 - 5) Other scenarios.
- c) Airframe Engine Combination Build Standards.
 - 1) Engine/APU Items. This statement applies equally to Engine manufacturer items, Engine Build Up Systems and Auxiliary Power Units on aeroplanes proposed to be used to conduct simulated ETOPS flights. Normally, the configuration, maintenance, and operating items identified in the current approved Configuration, Maintenance, and Procedures (CMP) document are implemented prior to the start of simulated ETOPS flights. However, items identified in the CMP document by an asterisk may be accomplished per the manufacturer's recommended schedule.
 - 2) Airframe Items. It is recommended that aeroplane proposed to be used in the simulated ETOPS program be configured to the CMP Build Standard for airframe items at the start of simulated ETOPS flights. Further, if certain equipment significantly impacts maintenance and/or operational procedures then TCCA may require that it may be installed early in the simulation period. Airframe items which the applicant intends to incorporate at a later date are to be identified in the application along with a schedule for compliance. During the final three months of the simulation period, all aeroplanes used to conduct simulated ETOPS flights are to fully comply with the CMP document.
 - 3) Equipment Required by the CARs for extended overwater flight. Any equipment required by the CARs for extended overwater flight, which is not installed at the start of simulated ETOPS operations, must be identified. They should present the PMI with a schedule for the installation of such equipment. If certain equipment significantly impacts maintenance and/or operational procedures then the POI and/or PMI, may require that equipment be installed early in the simulation period.
- d) Maintenance Control Systems. The simulation program must be designed to aid air operators in the development of decision-making processes through implementation of supplemental ETOPS maintenance and reliability requirements as specified in Chapter 4 of this manual. It is not within the scope of this Appendix to restate each required program element, but to outline the extent of their application in simulated programs. These are:
 - 1) Dispatch Considerations. All dispatch actions real or simulated including documentation of discrepancies must be completed prior to actual dispatch of the aeroplane. Air operators conducting ETOPS simulations have the same dispatch options as would be exercised in actual ETOPS operations. These considerations are:

- i) Minimum Equipment List (MEL). In instances in which the aeroplane does not meet the operator's ETOPS MEL requirements (but does meet non ETOPS requirements), dispatch options are to include:
 - A) Taking appropriate action to clear MEL and operate as an ETOPS segment;
 - B) Substitute an ETOPS capable aeroplane and operate as an ETOPS segment; or
 - C) Operate the flight as a non-ETOPS segment; and
 - ii) Domestic Verification Flights. Instances in which the air operator's program prescribes a domestic verification flight prior to ETOPS, dispatch options could include:
 - A) Substitute an ETOPS capable aeroplane and operate as an ETOPS segment.
 - B) Operate the flight as a non-ETOPS segment; or.
 - C) Perform the verification flight in accordance with the approved TC procedure and operate as an ETOPS segment.
- 2) ETOPS Destination Reliability Requirements. The excessive use of the option to operate as a non ETOPS segment is not desirable in that it indicates a lack of commitment to the ETOPS program. Therefore, during the period of simulation, it is recommended that ETOPS destination reliability remain at 98% or higher. The following details the ground rules for destination reliability requirements.
- i) An ETOPS flight is considered reliable if it arrives at its planned destination within 6 hours of its planned arrival time;
 - ii) If an ETOPS flight does not arrive at its intended destination within 6 hours of planned due to factors unrelated to the air operators maintenance or operations programs, then the flight may be counted as reliable. Passenger medical emergencies, air traffic flow control and flights rescheduled for passenger load considerations are examples of flights that would not be counted against the ETOPS destination reliability requirements;
 - iii) Flights which are conducted under the non ETOPS MEL are not considered as reliable for the destination reliability calculation;
 - iv) Any ETOPS designated flight which is unreliable under the criteria specified above must be reported to the principal maintenance inspector (PMI) within 72 hours of the event. The report must include:
 - A) If maintenance related, a description of the discrepancy or malfunction that caused the flight to be unreliable including operating under a non ETOPS MEL;
 - B) If operations-related, a description of the operational problem which caused the flight to be unreliable;
 - C) Chronology of the problem beginning with the first notification to maintenance or operations personnel up to the time of flight termination or cancellation;
 - D) The actions which followed initial notification of the problem;
 - E) Logistical aspects surrounding the availability of repair parts and/or required maintenance equipment at the station where the problem occurred; and
 - F) Any other information that may be deemed pertinent to the factors, which caused the flight to be unreliable; and
 - v) Destination reliability data must be compiled and reported to the PMI each month starting from commencement of ETOPS simulation. This report must include:

- A) The number of flights scheduled during the period and total number scheduled since start of ETOPS simulation;
 - B) The number of flights considered reliable and unreliable during the period and since start of ETOPS simulation;
 - C) The percentage of flights considered reliable during the period and since the start of ETOPS simulation; and
 - D) Inservice experience data to include inflight shutdown (IFSD) rates, (3 month, 6 month, 12 month rolling average, as agreed with the PMI), unscheduled engine removals and rates, delays and cancellations, airframe-engine hours and cycles, record of APU start and run reliability, and any other significant operator events required to be reported under the maintenance reliability program identified in Chapter 4. Data such as IFSD rates and events for portions of the applicant's airplane engine combination fleet which are not intended to be utilized in the ETOPS simulation also be reported.
- e) Operations Programs.
- 1) Training. Flight crew and dispatchers who participate in the simulation must have received ETOPS training prior to participation in the simulation; and
 - 2) Operations. Flights must be planned, dispatched and flown in accordance with this manual. All dispatch actions real or simulated including documentation of discrepancies must be completed prior to actual dispatch of the aeroplane. The following elements must be evaluated:
 - i) Critical fuel reserves and critical fuel requirements during ETOPS simulated flights;
 - ii) ETOPS alternate airports;
 - iii) Operational flight plans including diversion data such as Equal Time Points, critical fuel requirements, heading information;
 - iv) Minimum Equipment List (MEL) items;
 - v) Plotting charts, annotated during flight planning as they would for an actual flight.
 - vi) Communications capabilities in order to familiarize themselves with operational characteristics of HF communication and SATCOM; and
 - vii) Technical assistance, where exercise are conducted on selected flights to evaluate the availability and quality of assistance from maintenance technical centers.
- f) Number of operations are to be observed by TC maintenance and operations inspectors. Simulated malfunctions and contingencies must be given to determine the capability to respond correctly and expeditiously.

D.8 CONCEPT FOR DEMONSTRATION

The purpose of the demonstration phase is to gain experience and to validate effectiveness consistent with the highest level of safety over actual 180 minute routes. Flights conducted during the demonstration phase must be conducted utilizing applicable CARs and this manual's criteria for airframe engine configuration, maintenance, dispatch, and flight crew programs. The following must be addressed:

- a) Area of operation: The demonstration flights must be conducted over intended routes. Exact tracks, points of entry, diversion airports, and support facilities at origins and destinations should be established as if 180 minute authority were actually being exercised in regularly scheduled service;
- b) Sample size and timing: A minimum of twelve (one way) demonstration flights must be flown in the planned actual area of operations. The number of demonstration flights may be increased or decreased by the POI, on a case-by-case basis based on the factors identified in Paragraphs D.7 (b) (1) through (4). The

initial flight must be flown approximately 90 days prior to the date of anticipated 180 minute approval. The purpose of these flights is to demonstrate proof of concept in the exercise of all operational and maintenance factors. Results of these flights are used to modify the ETOPS program elements to assure that subsequent flights fully conform to desired profiles. so that the experience base built, repeatable, operations;

- c) ETOPS Maintenance and reliability requirements: The maintenance control system for the ETOPS demonstration flights must be fully developed and conform to the requirements of Chapter 4 of this Manual;
- d) Configuration compliance: All aeroplanes flying in the demonstration flights must comply to configuration requirements as established in the CMP Document and applicable CARs. Similarly, all training, dispatch, maintenance, and maintainability/reliability standards criteria must be in full conformance with this manual;
- e) Configuration delays. Should a delay occur in the configuration of the aeroplane (for example, due to part availability) the simulation program must be continued until ready to conduct demonstration flights;
- f) Flight profiles: Demonstration flight segments must be integrated into the operational schedule and submitted in advance to the POI. All flights must conform to the operations specifications and 180 minute ETOPS criteria;
- g) Diversion exercises. During the course of the demonstration flights, ETOPS diversion exercises must be conducted in accordance with the established ground rules, at a frequency and extent to be determined by TC. The demonstration diversions must be consistent with the guidelines established by TC for 180 minute ETOPS validation flights. Diversion exercises should not impact the applicant's destination reliability record or required number of simulation/demonstration flights; and
- h) Validation flight credit. At the discretion of TC, the final flight or flights conducted during the demonstration phase may be planned and conducted as the TC required ETOPS validation flight(s). This flight or flights must be coordinated between TC and the air operator well in advance. This provision does not alter the requirement to conduct simulation/demonstration for 12 consecutive months and approximately 1,000 flights.

D.9 CONCEPTS FOR PAPER AIRLINE EVALUATION

To validate the accuracy and repeatability of data sources, flight planning methodology and algorithms, and operational decision processes, a "paper airline" data assimilation and analysis must be conducted in parallel to both the simulation and demonstration phases and must address the following:

- a) Area of operation: The "paper airline" must be "flown" over the exact route(s) intended for the regularly scheduled ETOPS flights.
- b) Sample size and timing: A minimum of one flight per business day, per intended segment, must be planned. "Business day" is described as the period in which normal duties permit data retrieval and analysis. Where the frequency is less than daily, the "paper" scenario must still maintain a minimum analysis volume of at least 5 flights per week.
- c) Maintenance program. Although maintenance activity simulation cannot be accommodated in a quantitative analysis scenario of this type, it is recommended that maintenance alert and MEL notification mechanisms be regularly exercised and displayed in conjunction with flight planning releases.
- d) Configuration compliance. Not applicable, but it must be assumed that the "paper" airplane in the planning data base for the daily analyses is fully conformed to CMP and ETOPS MEL requirements.
- e) Paper flight analysis. For each paper flight, planned versus actual weather and facility status must be analyzed. Items to be analyzed include:

- 1) Actual versus forecast enroute ETOPS alternate, destination, and terminal alternate weather (ceiling, visibility, crosswind component, icing, runway);
 - 2) Actual versus forecast enroute weather;
 - 3) Actual versus forecast condition of navigation, communication and airport facilities for enroute, alternate, and terminal phase of flight; and
 - 4) Analysis of planned versus actual enroute wind and the resultant variation in planned fuel burnoff to determine impact on the critical fuel scenario.
- f) Presentation of data.: During the course of the domestic simulation phase, results from the ongoing daily “paper airline” analyses must be made available for the POI and PMI to review and comment.

D.10 ETOPS VALIDATION FLIGHT

ETOPS validation flight or flights must be conducted under the supervision of a TCCA Inspector in accordance with the requirements Paragraph 1.4.3 e) of this manual. The flight(s) may be scheduled approval of the air operator’s 180 minute ETOPS application (see Subsection D.8 g) for guidance on conducting validation flight or flights during the demonstration phase).