UAE General Civil Aviation Authority

دولة الامارات العربية المتحدة
الهيئة العامة للطيران المدني

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CIVIL AVIATION ADVISORY PUBLICATION

CAAP 21

(Revised on *01 October 2010)*

ETOPS

EXTENDED RANGE OPERATION WITH TWO ENGINE AEROPLANES

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1 PURPOSE

This CAAP states an acceptable means but not the only means for obtaining approval under CAR-OPS 1 for two-engine aeroplanes to operate over a route that contains a point further than one hour flying time at the approved one-engine inoperative cruise speed (refer to CAROPS 1.246 for specific performance category, seat configuration and take off mass) from an adequate aerodrome. This CAAP allows a continuous curve of diversion time versus propulsion system reliability, however steps of diversion time may be necessary for practical reasons (e.g., 90 minutes, 120 minutes, etc.). Operational requirements may also be related to diversion time. The content of the CAAP will be related to diversion time as follows:

(a) by having three sets of design criteria for 75 minutes or less, more than 75 but less than 90 minutes or above 90 minutes, except that diversion time may be a parameter for the assessment of certain systems;

(b) by applying the same set of criteria for maintenance;

(c) by having three sets of operational criteria: greater than 60 but less than or equal to 90 minutes: greater than 90 minutes but less than or equal to 120 minutes: greater than 120 minutes up to a maximum of 180 minutes.

Accelerated ETOPS (Operational Approval). Factors to allow reduction or substitution of operator's in-service experience when applying for Accelerated ETOPS, are contained in Appendix 7 of this CAAP. Each application will be dealt with by the Authority on a case by case basis and will be based on a specific approved plan (See Appendix 7).

Type Design Approval (TDA)

(a) 180 minutes ETOPS Approval is considered feasible at the introduction to service of an airframe/engine combination, as long as the Authority is totally satisfied that all aspects of the Approval Plan (CRI) have been completed. The Authority must be satisfied that an approval plan achieves an equivalent level of safety to that intended in that leaflet.

(b) Any deficiency in compliance with the Approved Plan can result in some lesser approval than that sought.

(c) Operators and Manufacturers will be required to respond to any incident or occurrence in the most expeditious manner. A serious single event or series of related events could result in immediate revocation of ETOPS approval. Any isolated problem not justifying immediate withdrawal of approval, must be included in a Certification Authority approved plan within 30 days.

Note: EASA AMC 20-6 is the basis of this CAAP. All related EASA certification specifications have been retained for ease of reference but this does not preclude the use of equivalent requirements for non EASA certified aircraft.

2 STATUS OF THIS CAAP

The first issue of CAAP - ETOPS dated 01 January, 2005 current revision is revision 1 , dated October 2010. It will remain current until withdrawn or superseded.

3 CONTENTS

4 TERMINOLOGY

(a) *Aerodrome*

(1) Adequate. For the purpose of this CAAP, an adequate aerodrome is an aerodrome, which the operator and the Authority consider to be adequate, having regard to the performance requirements applicable at the expected landing weight or mass. In particular, it should be anticipated that at the expected time of use:

(i) The aerodrome will be available, and equipped with necessary ancillary services, such as ATC, sufficient lighting, communications, weather reporting, navaids and emergency services. Rescue and Fire Fighting Services (RFFS) equivalent to ICAO category 4 (for RFFS not located on the aerodrome; capable of meeting the aeroplane with 30 minutes notice) or the relevant aeroplane category if lower, is acceptable for planning purposes only, when being considered as an ETOPS en-route alternate; and

(ii) At least one letdown aid (ground radar would so qualify) will be available for an instrument approach.

(2) Suitable. For the purpose of this CAAP a suitable aerodrome is an adequate aerodrome with weather reports, or forecasts, or any combination thereof, indicating that the weather conditions are at or above operating minima and the field condition reports indicate that a safe landing can be accomplished at the time of the intended operation (see Appendix 3).

(b) *Auxiliary Power Unit (APU)*

A gas turbine engine intended for use as a power source for driving generators, hydraulic pumps and other aeroplane accessories and equipment and/or to provide compressed air for aeroplane pneumatic systems.

(c) *ETOPS Configuration, Maintenance and Procedures (CMP) Standard*

The particular aeroplane configuration minimum requirements including any special inspection, hardware life limits, Master Minimum Equipment List (MMEL) constraints, and maintenance practices found necessary by the Authority to establish the suitability of an airframe-engine combination for extended range operation.

(d) *Engine*

The basic engine assembly as supplied by the engine manufacturer.

(e) *Extended Range Operations*

For the purpose of this CAAP, extended range operations are those flights conducted over a route that contains a point further than one hour flying time at the approved

one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate aerodrome.

(f) *Extended Range Entry Point*

The extended range entry point is the point on the aeroplane's outbound route which is one hour flying time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an adequate aerodrome.

(g) *Maintenance Personnel*

Mechanics, Licensed Ground Engineers, Maintenance Support Personnel.

(h) *In-flight Shutdown (IFSD)*

When an engine ceases to function in flight and is shutdown, whether self-induced, crew initiated or caused by some other external influence (i.e., In Flight Shutdown (IFSD) for all causes; for example: due to flameout, internal failure, crew-initiated shutoff, foreign object ingestion, icing, inability to obtain and/or control desired thrust).

(i) *ETOPS significant system*

(1) A system for which the fail-safe redundancy characteristics are directly linked to the number of engines, e.g., hydraulic system, pneumatic system, electrical system.

(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, e.g., fuel system, thrust reverser or engine control or indicating system, engine fire detection system.

(3) A system which contributes significantly to the safety of flight and a diversion with one engine inoperative, such as back-up systems used in case of additional failure during the diversion. These include back-up or emergency generator, APU or systems essential for maintaining the ability to cope with prolonged operation at single engine altitudes, such as anti-icing systems.

(4) A system for which certain failure conditions may reduce the safety of a diversion, e.g. navigation, communication, equipment cooling, time limited cargo fire suppression, oxygen 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 necessary to supply power for the equipment operation.

(i) Airframe System. Any system on the aeroplane that is not a part of the propulsion system.

(ii) Propulsion System. The aeroplane propulsion system includes: each component that is necessary for propulsion; components that affect the control of the major propulsion units; and components that affect the safe operation of the major propulsion units.

(j) *Approved One-Engine-Inoperative Cruise Speed*

(1) The approved one-engine-inoperative cruise speed for the intended area of operation shall be a speed, within the certificated limits of the aeroplane, selected by the operator and approved by the regulatory authority.

(2) The operator shall use this speed in

(i) establishing the outer limit of the area of operation and any dispatch limitation

(ii) calculation of single engine fuel requirements under section 10.(d)(4) Fuel and Oil Supply of this CAAP and

(iii) establishing the level off altitude (net performance) data. This level off altitude (net performance) must clear any obstacle en route by margins as specified in CAR-OPS 1.

(3) As permitted under section 10.(f)(3) of this CAAP, based on evaluation of the actual situation, the pilot in command has the authority to deviate from the planned one-engine-inoperative cruise speed.

5 DISCUSSION

To be eligible for extended range operations, the specified airframe-engine combination should have been certificated to the airworthiness standards of Transport Category Aeroplanes and should be evaluated considering the concepts in paragraph 7, evaluated considering the type design considerations in paragraph 8 and Appendix 2, evaluated considering in-service experience for ETOPS type design discussed in paragraph 9 or Approval Plan (CRI) for Accelerated ETOPS Type Design Approval and evaluated considering the continuing airworthiness and operational concepts outlined in paragraph 10.

6 APPLICABILITY AND GRANDFATHER CLAUSES

Applicability and grandfather clauses will be found, when appropriate, in CAR-OPS 1.

7 CONCEPTS

Although it is self-evident that the overall safety of an extended range operation cannot be better than that provided by the reliability of the propulsion systems, some of the factors related to extended range operation are not necessarily obvious. For example, cargo compartment fire suppression/containment capability could be a significant factor, or operational/maintenance practices may invalidate certain determinations made during the aeroplane type design certification

or the probability of system failures could be a more significant problem than the probability of propulsion system failures. Although propulsion system reliability is a critical factor, it is not the only factor which should be seriously considered in evaluating extended range operation. Any decision relating to extended range operation with two-engine aeroplanes should also consider the probability of occurrence of any conditions which would reduce the capability of the aeroplane or the ability of the crew to cope with adverse operating conditions. The following is provided to define the concepts for evaluating extended range operation with two-engine aeroplanes. This approach ensures that two-engine aeroplanes are consistent with the level of safety required for current extended range operation with three and four-engine turbine powered aeroplanes without unnecessarily restricting operation.

7.1 Airframe Systems

A number of airframe systems have an effect on the safety of extended range operation; therefore, the type design certification of the aeroplane should be reviewed to ensure that the design of these systems is acceptable for the safe conduct of the intended operation.

7.2 Propulsion Systems

In order to maintain a level of safety consistent with the overall safety level achieved by modern aeroplanes, it is necessary for two-engine aeroplanes used in extended range operation to have an acceptably low risk of significant loss of power/thrust for all design and operation related causes (see Appendix 1).

7.3 Maintenance and Reliability Programme Definition

Since the quality of maintenance and reliability programmes can have an appreciable effect on the reliability of the propulsion system and the airframe systems required for extended range operation, an assessment should be made of the proposed maintenance and reliability programme's ability to maintain a satisfactory level of propulsion and airframe system reliability for the particular airframe-engine combination.

7.4 Maintenance and Reliability Programme Implementation

Following a determination that the airframe systems and propulsion systems are designed to be suitable for extended range operation, an in-depth review of the applicant's training programmes, operations and maintenance and reliability programmes should be accomplished to show ability to achieve and maintain an acceptable level of systems reliability to safely conduct these operations.

7.5 Human Factors

System failures or malfunctions occurring during extended range operation could affect flight crew workload and procedures. Since the demands on the flight crew may

increase, an assessment should be made to ensure that more than average piloting skills or crew co-ordination are not required.

7.6 Approval Basis

Each applicant (manufacturer or operator as appropriate) for extended range Approval should show that the particular airframe-engine combination is sufficiently reliable. Systems required for extended range operation should be shown by the manufacturer to be designed to a fail-safe criteria and should be shown by the operator to be continuously maintained and operated at levels of reliability appropriate for the intended operation.

(1) *Type Design ETOPS Approval*

(i) The process which will normally lead to the type design ETOPS Approval can be divided into two steps:

(A) Eligibility for ETOPS: The applicant should show that the design features of the particular airframe-engine combination are suitable for the intended operations (see paragraph 8).

(B) Capability for ETOPS: The applicant should show that the particular airframe-engine combination, having been recognised eligible for ETOPS, can achieve a sufficiently high level of reliability in service so that safe extended range operation may be conducted. The achievement of the required level of propulsion system reliability is determined in accordance with Appendix 1 (see paragraph 9). The reliability of the airframe systems is determined in accordance with Appendix 2 (see paragraph 8).

(ii) Evidence that the type design of the aeroplane is approved for extended range operation is normally reflected by a statement in the Authority approved Aeroplane Flight Manual (AFM) and Type Certificate Data sheet which references the CMP standard requirements for extended range operations.

(2) *In-service experience*

It is also necessary for each operator desiring approval for extended range operation to show that it has obtained sufficient maintenance and operations experience with that particular airframe-engine combination to conduct safely these operations (see paragraph 10.(a)).

(3) *Operations Approval*

The type design approval does not reflect a continuing airworthiness or operational approval to conduct extended range operations. Therefore, before approval, each operator should demonstrate the ability to maintain and operate the

aeroplane so as to achieve the necessary reliability and to train its personnel to achieve the competence in extended operation. The operational approval to conduct an extended range operation is made by amendment to the operator certificate issued by the appropriate Authority (see paragraph 10) which includes requisite items provided in the AFM.

(4) *Continuing Airworthiness*

The type design ETOPS Approval holder and the Authority should periodically review the in-service reliability of the airframe-engine combination. Further to these reviews and every time that an urgent problem makes it necessary, the Authority may require that the type design CMP standard be revised to achieve and maintain the desired level of reliability and, therefore safety of the extended range operation. The CMP standard in effect prior to revision will no longer be considered suitable for continued extended range operation. The CMP standard and its revisions, may require priority actions to be implemented before the next ETOPS flight and other actions to be implemented according to a schedule accepted by the Authority.

Note: See also Appendix 1 paragraph (e) Continuing Airworthiness for Aircraft Systems. Periodically means in this context typically two years. This means that reviews are conducted every 24 months.

8 TYPE DESIGN APPROVAL CONSIDERATION FOR ELIGIBILITY

When a two-engine type design aeroplane is intended to be used in extended range operations, a determination should be made that the design features are suitable for the intended operation. In some cases modifications to systems may be necessary to achieve the desired reliability. The essential airframe systems and the propulsion system for the particular airframe-engine combination should be shown to be designed to fail-safe criteria and through service experience it must be determined that it can achieve a level of reliability suitable for the intended operation.

(a) *Request for Approval*

An aeroplane manufacturer or other civil airworthiness Authorities, requesting a determination that a particular airframe-engine combination is a suitable type design for extended range operation, should apply to the Certification Authority. The Certification Authority will then initiate an assessment of the airframe-engine combination in accordance with paragraphs 8, 9 and Appendix 1 & 2 of this CAAP.

(b) *Criteria*

The applicant should conduct an evaluation of failures and failure combinations based on engineering and operational consideration as well as acceptable fail-safe methodology. The analysis should consider effects of operations with a single engine,

including allowance for additional stress that could result from failure of the first propulsion system. 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. The following criteria are applicable to the extended range operation of aeroplanes with two engines:

(1) Airframe systems should be shown to comply with CS 25.1309.

(2) The propulsion systems should be shown to comply with CS 25.901.

(i) Engineering and operational judgement applied in accordance with the guidance outlined in paragraph 9 and Appendix 1 should be used to show that the propulsion system can achieve the desired level of reliability.

(ii) Contained engine failure, cascading failures, consequential damage or failure of remaining systems or equipment should be assessed in accordance with CS 25.901.

(iii) It should be shown during type design evaluation that adequate engine limit margins exist (i.e., rotor speed, exhaust gas temperatures) for conducting extended duration single-engine operation during the diversion at all approved power levels and in all expected environmental conditions. The assessment should account for the effects of additional engine loading demands (e.g., anti-icing, electrical, etc.) which may be necessary during the single-engine flight phase associated with the diversion (see Appendix 4).

Note: Adequate, as referred to in first line of 8.(b)(2)(iii), means that engine limits margins after allowing for the effects of additional loading demands associated with single-engine flight will not exceed the approved engine limits at a particular power setting.

(3) The safety impact of an uncontained engine failure should be assessed in accordance with CS 25.903, CS-E 510 and CS-E 520

(4) The APU installation, if required for extended range operations, should meet the applicable CS 25 provisions (Subpart J, APU) and any additional requirements necessary to demonstrate its ability to perform the intended function as specified by the Authority following a review of the applicant's data.
If a certain extended range operation may necessitate in-flight start and run of the APU, it must be substantiated that the APU has adequate capability and reliability for that operation.

(5) Extended duration, single-engine operations should not require exceptional piloting skills and/or crew co-ordination. Considering the 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 should be minimised. Consideration should also be given to the effects of continued flight with an

engine and/or airframe system inoperative on the flight crew's and passengers' physiological needs (e.g., cabin temperature control).

(6) It should be demonstrated for extended duration single-engine operation, that the remaining power (electrical, hydraulic, pneumatic) will continue to be available at levels necessary to permit continued safe flight and landing, and to provide those services necessary for the overall safety of the passengers and crew. Unless it can be shown that cabin pressure can be maintained on single-engine operation at the altitude necessary for continued flight to a suitable aerodrome, oxygen should be available to sustain the passengers and crew for the maximum diversion time.

(7) In the event of any single failure, or any combination of failures not shown to be Extremely Improbable, it should be shown that electrical power is provided for essential flight instruments, warning systems, avionics, communications, navigation, required route or destination guidance equipment, supportive systems and/or hardware and any other equipment deemed necessary for extended range operation to continue safe flight and landing at a suitable aerodrome. Information provided to the flight crew should be of sufficient accuracy for the intended operation. Functions to be provided may differ between aeroplanes and should be agreed with the Authority. These should normally include:

(i) attitude information;

(ii) adequate radio communication and intercommunication capability;

(iii) adequate navigation capability (including weather radar);

(iv) adequate cockpit and instrument lighting, Emergency lighting and landing lights;

(v) sufficient captain and first officer instruments, provided cross-reading has been evaluated;

(vi) heading, airspeed and altitude including appropriate pitot/static heating;

(vii) adequate flight controls including auto-pilot;

(viii) adequate engine controls, and restart capability with critical type fuel (from the stand-point of flame out and restart capability) and with the aeroplane initially at the maximum relight altitude;

(ix) adequate fuel supply system capability including such fuel boost and fuel transfer functions that may be necessary;

(x) adequate engine instrumentation;

(xi) such warning, cautions, and indications as are required for continued safe flight and landing;

(xii) fire protection (cargo, APU and engines);

(xiii) adequate ice protection including windshield de-icing;

(xiv) adequate control of cockpit and cabin environment including heating and pressurisation; and,

(xv) ATC Transponder.

Note: For 90 minutes or less ETOPS operations, the functions to be provided must satisfy the requirements of CS 25.1351(d)(2) as interpreted by AMC 25.1351(d)(4) and (5).

(8) Three or more reliable and independent electrical power sources should be available. As a minimum, following failure of any two sources, the remaining source should be capable of powering the items specified in paragraph 8.(b)(7). If one or more of the required electrical power sources are provided by an APU, hydraulic system, or ram air turbine, the following criteria apply as appropriate:

(i) The APU, when installed, should meet the criteria in paragraph 8.(b)(4).

(ii) The hydraulic power source should 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).

(iii) The Ram Air Turbine (RAT) should be demonstrated to be sufficiently reliable in deployment and use. The RAT should not require engine dependent power for deployment.

Note: For 75 minutes or less ETOPS operations, if one of the required electrical power sources is provided by batteries, the following criteria apply:

The electrical power and distribution system including the standby or alternate power system, should comply with the requirements of CS 25.1351 and associated AMC‘s. Where the alternate power source provided to comply with CS 25.1351(d) is time limited (e.g. batteries), such a power source should have a capability to enable the items required by the verifying authority in paragraph 8.(b)(7) to be powered for the maximum certificated diversion time in still air conditions, plus an allowance for holding, approach and landing, and the likely prevailing weather conditions for the planned routes ,(e.g. an allowance for headwinds).

(9) It should be shown that adequate status monitoring information and procedures on all critical systems are available for the flight crew to make pre-flight, in-flight go/no-go and diversion decisions.

(10) Extended range operations are not permitted with time-related cargo fire limitations less than the approved maximum diversion time in still air conditions (plus an allowance for 15 minutes holding an approach and landing, and the likely prevailing weather conditions for the planned route, e.g. allowance for headwinds)

determined by considering other relevant failures, such as an engine inoperative, and combinations of failures not shown to be Extremely Improbable.

(11) Airframe and propulsion ice protection should be shown to provide adequate capability (aeroplane controllability, etc.) for the intended operation. This should account for prolonged exposure to lower altitudes associated with the single engine diversion, cruise, holding, approach and landing.

(12) *Solutions to achieve required reliability*

The permanent solution to a problem should be, as far as possible, a hardware/design solution. However, if scheduled maintenance, replacement, and/or inspection are utilised to obtain type design approval for extended range operation, and therefore are required in the CMP standard document, this type of solution should normally be temporary and the specific maintenance information should be easily retrievable and clearly referenced and identified in an appropriate maintenance document.

(c) *Analysis of Failure Effects and Reliability*

(1) *General*

The analysis and demonstration of airframe and propulsion system failure effects and reliability provided by the applicant as required by paragraph 8.(b) should be based on in-service experience as required by paragraph 9, and the expected longest diversion time for extended range routes likely to be flown with the aeroplane. If it is necessary in certain failure scenarios to consider less time due to time limited systems, the latter will be established as the maximum diversion time.

(2) *Propulsion systems*

(i) An assessment of the propulsion system's reliability for particular airframe-engine combinations should be made in accordance with paragraph 9 and Appendix 1.

(ii) The analysis should consider:

(A) Effects of operation with a single-propulsion system (i.e., high-power demands including extended use of MCT and bleed requirements, etc.) and include possible damage that could result from failure of the first propulsion system.

(B) Effects of the availability and management of fuel for propulsion system operation (i.e., cross-feed valve failures, fuel mismanagement, ability to detect and isolate leaks, etc.).

(C) Effects of other failures, external conditions, maintenance and crew errors, that could jeopardise the operation of the remaining propulsion system, should be examined.

(D) Effect of inadvertent thrust reverser deployment, if not shown to be Extremely Improbable (includes design and maintenance).

(3) *Hydraulic Power and Flight Control*

An analysis should be carried out taking into account the criteria detailed in paragraph 8.(b)(6). Consideration of these systems may be combined, since many commercial aeroplanes have full hydraulically powered controls. For aeroplanes with all flight controls being hydraulically powered, evaluation of hydraulic system redundancy should show that single failures or failure combinations, not shown to be Extremely Improbable, do not preclude continued safe flight and landing at a suitable aerodrome. As part of this evaluation, the loss of any two hydraulic systems and any engine should be assumed to 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.

Note: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.(b) will not be required for airframe systems, where for basic (non ETOPS) Type Design Approval (TDA), compliance with CS 25.1309, or its equivalent, has already been shown.

(4) *Services Provided by Electrical Power*

An analysis should show that the criteria detailed in paragraphs 8.(b)(6), (7) and (8) are satisfied taking into account the exposure times established in paragraph 8.(c)(1).

Note: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.b will not be required for airframe systems, where for basic (non ETOPS) Type Design Approval (TDA), compliance with CS 25.1309, or its equivalent, has already been shown.

(5) *Equipment Cooling*

An analysis should establish that the equipment (including avionics) necessary for extended range operation has the ability to operate acceptably following failure modes in the cooling system not shown to be Extremely Improbable. Adequate indication of the proper functioning of the cooling system should be demonstrated to ensure system operation prior to dispatch and during flight.

Note: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.b will not be required for airframe systems, where for basic (non ETOPS) Type Design Approval (TDA), compliance with CS 25.1309, or its equivalent, has already been shown.

(6) *Cargo Compartment*

It should be shown that the cargo compartment design and fire protection system capability (where applicable) is consistent with the following:

(i) Design

The cargo compartment fire protection system integrity and reliability should be suitable for the intended operation considering fire detection sensors, liner materials, etc.

(ii) Fire Protection

An analysis or tests should be conducted to show, considering approved maximum diversion in still air (including an allowance for 15-minute holding and/or approach and land), that the ability of the system to suppress or extinguish fires is adequate to ensure safe flight and landing at a suitable aerodrome.

(7) Reserved

(8) *Cabin Pressurisation*

A review of fail-safe and redundancy features should show that the loss of cabin pressure is Improbable under single-engine operating conditions. Authority approved aeroplane performance data should be available to verify the ability to continue safe flight and landing after loss of pressure and subsequent operation at a lower altitude (see also paragraph 8.(b)(6)).

(9) *Cockpit and Cabin Environment*

The analysis should show that an adequate cockpit and cabin environment is preserved following all combinations of propulsion and electrical system failures which are not shown to be Extremely Improbable.

Note: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.b will not be required for airframe systems, where for basic (non ETOPS) Type Design Approval (TDA), compliance with CS 25.1309, or its equivalent, has already been shown.

(d) *Assessment of Failure Conditions*

In assessing the fail-safe features and effects of failure conditions, account should be taken of:

(1) The variations in the performance of the system, the probability of the failure(s), the complexity of the crew action.

(2) Factors alleviating or aggravating the direct effects of the initial failure condition, including consequential or related conditions existing within the aeroplane which

may affect the ability of the crew to deal with direct effects, such as the presence of smoke, aeroplane accelerations, interruption of air-to-ground communication, cabin pressurisation problems, etc.

(3) A flight test should be conducted by the manufacturer and witnessed by the Certification Authority to validate expected aeroplane flying qualities and performance considering propulsion system failure, electrical power losses, etc. The adequacy of remaining aeroplane systems and performance and flight crew ability to deal with the emergency, considering remaining flight deck information, will be assessed in all phases of flight and anticipated operating conditions. Depending on the scope, content, and review by the Certification Authority of the manufacturer's data base, this flight test could also be used as a means for approving the basic aerodynamic and engine performance data used to establish the aeroplane performance identified in paragraph 10.(d)(6).

(e) *Authority Aeroplane Assessment Report*

The assessment of the reliability of propulsion and airframe systems for a particular airframe-engine combination will be contained in an Authority - approved Aeroplane Assessment Report. This report will be approved by the Certification Authority after review and concurrence by the Authority responsible for Operations. In the case of a subsequent Certification Authority, the report may incorporate partly or totally the report established by the original Authority. Following approval of the report, the propulsion and airframe system recommendations will be included in an Authority-approved document that establishes the CMP standard requirements for the candidate aeroplane. This document will then be referenced in the Operation Specification and the Aeroplane Flight Manual.

(f) *ETOPS Type Design Approval*

Upon satisfactory completion of the aeroplane evaluation through an engineering inspection and test programme consistent with the type certification procedures of the Authority and sufficient in-service experience data. (see Appendix 1 & 2)

(1) The type design approval will be reflected in the approved AFM or supplement, and Type Certification Data Sheet or Supplemental Type Certificate which contain directly or by reference the following pertinent information, as applicable:

(i) special limitations (if necessary), including any limitations associated with a maximum diversion time established in accordance with paragraph 8.(c)(1);

(ii) additional markings or placards (if required);

(iii) revision to the performance section in accordance with paragraph 10.(d)(6);

(iv) the airborne equipment, installation, and flight crew procedures required for extended range operations;

(v) description or reference to a document containing the approved aeroplane configuration CMP standard;

(vi) a statement to the effect that:

"The type design reliability and performance of this airframe-engine combination has been evaluated in accordance with CAAP 21 and found suitable for (state maximum diversion time) extended range operations with the incorporation of the approved aeroplane configuration CMP standard. This finding does not constitute approval to conduct extended range operations".

(g) *Type Design Change Process*

(1) The Authority responsible for the certification of the airframe-engine combination type design will include the consideration of extended range operation in its normal monitoring and design change approval functions.

(2) The Propulsion System Reliability Assessment Board (PSRAB) will periodically check that the propulsion system reliability requirements for extended range operation (see Appendix 1) are achieved or maintained.

Note: Periodically means in this context two years.

(3) Any significant problems which adversely affect extended range operation will be corrected. Modifications or maintenance actions to achieve or maintain the reliability objective of extended range operations for the airframe-engine combination will be incorporated into the design CMP standard document. The Authority will co-ordinate this action with the affected manufacturer and operator.

(4) The Airworthiness Directive process may be utilised as necessary to implement a CMP standard change.

(h) *Continued Airworthiness*

The type design CMP standard which establishes the suitability of an aeroplane for extended range operation defines the minimum standard for the operation. Additional modifications or maintenance actions generated by an operator or manufacturer to enhance or maintain the continued airworthiness of the aeroplane must be made through the normal approval process. The operator or manufacturer (as appropriate) should thoroughly evaluate such changes to ensure that they do not adversely affect reliability or conflict with requirements for extended range approval.

9 IN-SERVICE EXPERIENCE - ETOPS TYPE DESIGN APPROVAL

In establishing the suitability of a type design in accordance with paragraph 8 of this CAAP and as a pre-requisite to obtaining any operational approval in accordance with the criteria of paragraph 10 of this CAAP, it should be shown that an acceptable level of propulsion system and airframe systems reliability can be or has been achieved in service by the world fleet for the particular airframe-engine

combination. For this purpose, prior to the type design approval, paragraph 8, it should be shown that the world fleet of the particular airframe-engine combination for which approval is sought can achieve or has achieved, as determined by the Authority (see Appendix 1), an acceptable and reasonably stable level of single propulsion system in-flight shutdown (IFSD) rate and airframe system reliability. Engineering and operational judgement applied in accordance with the guidance outlined in Appendix 1 will then be used to determine that the IFSD rate objective for all independent causes can be or has been achieved. This assessment is an integral part of the determination in paragraph 8.(b)(2) for type design approval.

This determination of propulsion system reliability is derived from a world fleet data base containing, in accordance with requirements of Appendix 1, all in-flight shutdown events, all significant engine reliability problems, design and test data and available data on cases of significant loss of thrust, including those where the propulsion system failed or the engine was throttled back or shut down by the pilot. This determination will take due account of the approved maximum diversion time, proposed rectification of all identified propulsion and ETOPS significant systems problems, as well as events where in-flight starting capability may be degraded.

10 OPERATIONAL APPROVAL CONSIDERATIONS

Three sets of criteria are to be used:

- Operational approval criteria for extended range operations with a maximum diversion time of 90 minutes or less to an en-route alternate (at the approved one-engine-inoperative cruise speed under standard conditions in still air). Paragraphs 10.(a). to 10.(i) and Appendix 5 apply.

- Operational approval for extended range operations with a maximum diversion time above 90 minutes up to 120 minutes to an en-route alternate (at the approved one-engine-inoperative cruise speed under standard conditions in still air). Paragraph 10.(a) to 10.(i) applies.

- Operational approval for extended range operations with a maximum diversion time above 120 minutes up to 180 minutes to an en-route alternate (at the approved one-engine-inoperative cruise speed under standard conditions in still air). Paragraph 10(j) applies in addition to 10.(a) to 10.(i).

Purposes of Appendices:

Appendices 3, 4 and 5 provide additional and expanded explanations on the requirements for en-route alternates and maintenance requirements respectively.

(a) *Requesting Approval*

Any operator requesting approval for extended range operations with two-engine aeroplanes (after the satisfaction of the considerations in paragraphs 8 and 9) should submit the requests, with the required supporting data, to the Authority at least 3 months prior to the proposed start of extended range operation with the specific airframe-engine combination.

(1) *In-service Experience for Operational Approval*

Each operator requesting Approval will be required to have appropriate experience. A summary shall be provided to the Authority, indicating the operator's capability to maintain and operate the specific airframe-engine combination for the intended extended range operation.
This summary should include experience with the engine type or related engine types, experience with the aeroplane systems or related aeroplane systems, or experience with the particular airframe-engine combination on non-extended range routes. Approval would be based on a review of this information.

Note 1: Additional information regarding Reduction of Operator's in-service experience is contained in Appendix 7.

Note 2: The operator's authorised maximum diversion time may be progressively increased by the Authority as the operator gains experience on the particular airframe-engine combination. Not less than 12 consecutive months experience will normally be required before authorisation of 120 minutes maximum diversion time, unless the operator can show compensating factors. The factors to consider may include calendar time, total number of flights, operator's diversion events, record of the airframe-engine combination with other operators, quality of operator's programmes and route structure. However, the operator will still need, in the latter case, to demonstrate his capability to maintain and operate the new airframe-engine combination at a similar level of reliability.

(2) In considering an application from an operator to conduct extended range operations, an assessment should be made of the operator's overall safety record, past performance, flight crew training and experience, and maintenance programme. The data provided with the request should substantiate the operator's ability and competence to safely conduct and support these operations and should include the means used to satisfy the considerations outlined in this paragraph. (Any reliability assessment obtained, either through analysis or service experience, should be used as guidance in support of operational judgements regarding the suitability of the intended operation.)

(b) *Assessment of the Operator's Propulsion System Reliability*

Following the accumulation of adequate operating experience by the world fleet of the specified airframe-engine combination and the establishment of an IFSD rate objective in accordance with Appendix 1 for use in ensuring the propulsion system reliability necessary for extended range operations, an assessment should be made of the applicant's ability to achieve and maintain this level of propulsion system reliability. This assessment should include trend comparisons of the operator's data with other operators as well as the world fleet average values, and the application of a qualitative judgement that considers all of the relevant factors. The operator's past record of propulsion system reliability with related types of power units should also be reviewed, as well as its record of achieved systems reliability with the airframe-engine combination for which authorisation is sought to conduct extended range operations.

Note: Where statistical assessment alone may not be applicable, e.g., when the fleet size is small, the applicant's experience will be reviewed on a case-by-case basis.

(c) *Engineering Modifications and Maintenance Programme Considerations*

Although these considerations are normally part of the operator's continuing airworthiness programme, the maintenance and reliability programme may need to be supplemented in consideration of the special requirements of extended range operation (Appendix 4). The following items, as part of the operator's programme will be reviewed to ensure that they are adequate for extended range operations:

(1) *Engineering Modifications*

The operator should provide to the Authority all titles and numbers of all modifications, additions, and changes which were made in order to substantiate the incorporation of the CMP standard in the aeroplanes used in extended range operation.

(2) *Maintenance Procedures*

Following Approval of the changes in the maintenance and training procedures, substantial changes to maintenance and training procedures, practices, or limitations established to qualify for extended range operations should be submitted to the Authority at least two months before such changes may be adopted.

(3) *Reliability Reporting*

The reliability reporting programme as supplemented and approved, should be implemented prior to and continued after approval of extended range operation. Data from this process should result in a suitable summary of problem events, reliability trends and corrective actions and be provided regularly to the Authority and to the relevant airframe and engine manufacturers. Appendix 4 contains additional information concerning propulsion and airframe system reliability monitoring and reporting.

(4) *Implementation*

Approved modifications and inspections which would maintain the reliability objective for the propulsion and airframe systems as a consequence of Airworthiness Directive (AD) actions and/or revised CMP standards should be promptly implemented.

Note: In principle, the CMP does not repeat Airworthiness Directives. An operator thus needs to ensure compliance with both the ADs applicable in its country and the CMP standards when operating ETOPS.

Other recommendations made by the engine and airframe manufacturers should also be considered for prompt implementation. This would apply to both installed and spare parts. The ETOPS operational approval of each ETOPS operator will

require it to keep its ETOPS fleets in conformity with the current CMP standards, taking into account implementation delays (see paragraph 7.(f)(4)).

(5) *Control Process*

Procedures and a centralised control process should be established which would preclude an aeroplane being released for extended range operation after propulsion system shutdown or primary airframe system failure on a previous flight, or significant adverse trends in system performance, without appropriate corrective action having been taken. Confirmation of such action as being appropriate, in some cases, may require the successful completion of one or more non-revenue or non-ETOPS revenue flights (as appropriate) prior to being released on an extended range operation.

(6) *Programmes*

The maintenance programme used, will ensure that the airframe and propulsion systems will continue to be maintained at the level of performance and reliability necessary for extended range operation, including such programmes as engine condition monitoring and engine oil consumption monitoring.

(d) *Flight Preparation and In-flight Considerations*

(1) *General*

The flight release considerations specified in this section are in addition to, or amplify, the requirements contained in CAR-OPS 1 and specifically apply to extended range operations. Although many of the considerations in this CAAP are currently incorporated into approved programmes for other aeroplanes or route structures, the unique nature of extended range operations with two-engine aeroplanes necessitates a re-examination of these operations to ensure that the Approved programmes are adequate for this purpose.

(2) *Minimum Equipment List (MEL)*

System redundancy levels appropriate to extended range operations should be reflected in the Master Minimum Equipment List (MMEL). An operator's MEL may be more restrictive than the MMEL considering the kind of extended range operation proposed and equipment and service problems unique to the operator. Systems considered to have a fundamental influence on flight safety may include, but are not limited to, the following:

(i) electrical, including battery;
(ii) hydraulic;

(iii) pneumatic;

(iv) flight instrumentation;

(v) fuel;

(vi) flight control;

(vii) ice protection;

(viii) engine start and ignition;

(ix) propulsion system instruments;

(x) navigation and communications;

(xi) auxiliary power-unit;

(xii) air conditioning and pressurisation;

(xiii) cargo fire suppression;

(xiv) engine fire protection;

(xv) emergency equipment; and

(xvi) any other equipment necessary for extended range operations.

(3) *Communication and Navigation Facilities*

An aeroplane should not be released on an extended range operation unless:

(i) Communications facilities are available to provide under normal conditions of propagation at the appropriate one-engine-inoperative cruise altitudes, reliable two-way voice communications between the aeroplane and the appropriate air traffic control unit over the planned route of flight and the routes to any suitable alternate to be used in the event of diversion.

(ii) Non-visual ground navigation aids are available and located so as to provide, taking account of the navigation equipment installed in the aeroplane, the navigation accuracy necessary for 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; and

(iii) Visual and non-visual aids are available at the specified alternates for the anticipated types of approaches and operating minima.

(4) *Fuel and Oil Supply*

(i) General

An aeroplane should not be released on an extended range operation unless it carries sufficient fuel and oil to meet the requirements of CAR-OPS 1 and any additional fuel that may be determined in accordance with paragraph

10.(d)(4)(ii). In computing fuel requirements, at least the following should be considered as applicable:

(A) Current forecast winds and meteorological conditions along the expected flight path at the appropriate one-engine-inoperative cruise altitude and throughout the approach and landing;

(B) Any necessary operation of ice protection systems and performance loss due to ice accretion on the unprotected surfaces of the aeroplane;

(C) Any necessary operation of Auxiliary Power Unit (APU);

(D) Loss of aeroplane pressurisation and air conditioning; consideration should be given to flying at an altitude meeting oxygen requirements in the event of loss of pressurisation;

(E) An approach followed by a missed approach and a subsequent approach and landing;

(F) Navigational accuracy necessary; and

(G) Any known Air Traffic Control (ATC) constraints.

Note: APU oil consumption should also be considered as necessary.

(ii) Critical Fuel Reserves

In establishing the critical fuel reserves, the applicant is to determine the fuel necessary to fly to the most critical point and execute a diversion to a suitable alternate under the conditions outlined in paragraph 10.(d)(4)(iii), the 'Critical Fuel Scenario'. These critical fuel reserves should be compared to the normal applicable operational rule requirements for the flight. If it is determined by this comparison that the fuel to complete the critical fuel scenario exceeds the fuel that would be on board at the most critical point, as determined by applicable operational rule requirements, additional fuel should be included to the extent necessary to safely complete the critical fuel scenario.
In consideration of the items listed in paragraph 10.(d)(4)(i), the critical fuel scenario should allow for a contingency figure of 5 per cent added to the calculated fuel burn from the critical point to allow for errors in wind forecasts, a 5 per cent penalty in fuel mileage **, any Configuration Deviation List items, both airframe and engine anti-icing; and account for ice accumulation on unprotected surfaces if icing conditions are likely to be encountered during the diversion.
If the APU is a required power source, then its fuel consumption should be accounted for during the appropriate phase(s) of flight.

(** or operator's demonstrated value for in-service deterioration in cruise fuel mileage)

(iii) Critical Fuel Scenario

The following describes a scenario for a diversion at the most critical point. The applicant should confirm the scenario to be used when calculating the critical fuel reserve necessary. it is operationally the most critical when considering both time and aeroplane configuration (e.g., two-engine versus one-engine at 10 000 feet non-standard aeroplane configuration not shown to be Extremely Improbable, paragraph 8.(c)(2)(ii)(D)):

(A) At the critical point, consider simultaneous failure of one propulsion system and the pressurisation system (critical point based on time to a suitable alternate at the approved one-engine-inoperative cruise speed).

(B) Immediate descent to and continued cruise at 10 000 feet at the relevant one-engine-inoperative cruise speed or continued cruise above 10 000 feet if the aeroplane is equipped with sufficient supplemental oxygen in accordance with CAR-OPS 1.

(C) Upon approaching the ETOPS en-route alternate, descent to 1 500 feet above destination, hold for 15 minutes, initiate an approach followed by a missed approach and then execute a normal approach and landing.

(5) *Alternate Aerodromes*

An aeroplane should not depart on an extended range operation unless the required take-off, destination and alternate aerodromes, including suitable en-route alternate aerodromes, to be used in the event of propulsion system failure or aeroplane system failure(s) which require a diversion, are listed in the cockpit documentation (e.g. computerised flight plan). Suitable en-route alternates should also be identified and listed in operational flight plan for all cases where the planned route of flight contains a point more than one hour flying time at the one-engine-inoperative speed from an adequate aerodrome. Since these suitable en-route alternates serve a different purpose than the destination alternate aerodrome and would normally be used only in the event of an engine failure or the loss of primary aeroplane systems, an aerodrome should not be listed as a suitable en-route alternate unless:

(i) The landing distances required as specified in the AFM for the altitude of the aerodrome, 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 aerodrome authorities and computed in accordance with CAR-OPS 1.

(ii) The aerodrome services and facilities are adequate to permit the conduct of an instrument approach procedure to the runway expected to be used while complying with the applicable aerodrome operating minima.

(iii) 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 aerodrome, equals or exceeds the authorised weather minima for en-route alternate aerodromes in Appendix 3. In addition, for the same period, the forecast crosswind component, including gusts, for the landing runway expected to be used should not exceed the maximum permitted crosswind for single engine landing taking into account the runway condition (dry, wet or contaminated).

(iv) During the course of the flight, the flight crew are to continue to remain informed of any significant changes in conditions at designated en-route alternates. Prior to proceeding beyond the extended range entry point, the forecast weather for the time periods established in paragraph 10.(d)(5)(iii), aeroplane status, fuel remaining, runway surface conditions, landing distances and aerodrome services and facilities at designated en-route alternates should be evaluated. If any conditions are identified (such as weather forecast below landing minima) which would preclude safe approach and landing, then the pilot should take an appropriate course of action.

(v) In addition, the operator's programme should provide flight crews with information on adequate aerodromes appropriate to the route to be flown which are not forecast to meet Appendix 3 en-route alternate weather minima. Aerodrome facility information and other appropriate planning data concerning these aerodromes should be provided to flight crews for use when executing a diversion.

Note: The alternate aerodromes should be chosen in order to make it possible for the aeroplane to reach the alternate while complying with the requirements, especially with regard to performance (flight over obstacles) and/or oxygen considerations.

(6) *Aeroplane Performance Data*

No aeroplane should be released on an extended range flight unless the operator's Operations Manual contains sufficient data to support the critical fuel reserve and area of operations calculation. The following data should be based on Authority-approved information (see paragraph 8.(d)(3)) provided or referenced in the Aeroplane Flight Manual (AFM).

(i) Detailed one-engine-inoperative performance data including fuel flow for standard and non-standard atmospheric conditions and as a function of airspeed and power setting, where appropriate, covering:

(A) driftdown (includes net performance);

(B) cruise altitude coverage including 10 000 feet;

(C) holding;

(D) altitude capability (includes net performance); and

(E) missed approach.

(ii) 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:

(A) Cruise (altitude coverage including 10 000 feet); and

(B) Holding.

(iii) Details of any other conditions relevant to extended range operation which can cause significant deterioration of performance, such as ice accumulation on the unprotected surfaces of the aeroplane, Ram Air Turbine (RAT) deployment, thrust reverser deployment, etc.

(iv) 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 CAR-OPS 1.

(e) *Flight Crew Training, Evaluation, and Operating Manuals*

(1) Adequacy of Flight Crew Training and Operating Manuals

The Authority will review in-service experience of significant aeroplane systems. The review will include system reliability levels and individual event circumstances, including crew actions taken in response to equipment failures or unavailabilities. The aviation industry should provide information for and participate in these reviews. The Authority will use the information resulting from these reviews to modify or update flight crew training programmes, operating manuals and checklists, as necessary.

(2) Flight Crew Training and Evaluation Programme

The operator's training programme in respect to extended range operations should provide training for flight crew members followed by subsequent evaluations and proficiency checks as well as refresher training in the following areas:

(i) Introduction to ETOPS regulations

(ii) Routes and aerodromes intended to be used in the ETOPS area of operations

(iii) Performance:

(A) Flight planning, including all contingencies.

(B) Flight performance progress monitoring.

(iv) Procedures:

(A) Diversion Procedures and Diversion 'Decision making'. Special initial and recurrent training to prepare flight crews to evaluate probable propulsion and airframe systems failures should be conducted. The goal of this training should be to establish crew competency in dealing with the most probable operating contingencies.

(B) Use of appropriate navigation and communication systems, including appropriate flight management devices.

(C) The flight crew should be provided with detailed initial and recurrent training which emphasises abnormal and emergency procedures to be followed in the event of foreseeable failures for each area of operation, including:

(1) Procedures for single and multiple failures in flight that would precipitate go/no-go and diversion decisions. If standby sources of electrical power significantly degrade cockpit instrumentation to the pilots, then approved training which simulates approach with the standby generator as the sole power source should be conducted during initial and recurrent training.

(2) Operational restrictions associated with these failures including any applicable Minimum Equipment List (MEL) considerations.

(3) Procedures for air start of the propulsion systems, including the APU, if required.

(4) Crew incapacitation

(D) Use of emergency equipment including protective breathing and ditching equipment.

(E) Procedures to be followed in the event that there is a change in conditions at designated en-route alternates which would preclude safe approach and landing.

(F) Understanding and effective use of approved additional or modified equipment required for extended range operations.

(G) Fuel Management

Flight crew should be trained on the fuel management procedures to be followed during the en-route portion of the flight. These procedures should provide for an independent cross-check of fuel quantity indicators. For example fuel flows could be used to calculate fuel burned and compared to indicated fuel remaining.

(H) Operators should develop and incorporate annual ETOPS refresher training programmes for flight crew qualified for ETOPS operations.

(3) *ETOPS Check Programme*

The objective of the ETOPS check programme should be to ensure standardised flight crew practices and procedures and also to emphasis the special nature of ETOPS operations. Only pilots with a demonstrated understanding of the unique requirements of ETOPS should be designated as check pilots for ETOPS.

(f) *Operational Limitations*

(1) *Area of Operation*

(i) An operator may be authorised to conduct extended range operations within an area where the diversion time, at any point along the proposed route of flight to an adequate aerodrome, is up to a maximum of 180 minutes in still air at the approved one-engine-inoperative cruise speed. Appendices 1 and 4 provide criteria for such operations.

(ii) In the case of operations cleared up to 120 minutes maximum diversion time, small increases in the diversion time for specific routes may be approved as needed, if it can be shown that the resulting routing will provide an enhancement of overall safety. Such increases:

(A) Will require the Authority to assess overall type design including time limited systems, demonstrated reliability; and

(B) to establish an appropriate MEL related to the diversion time required; and

(C) Will not be more than 15 per cent of the original maximum diversion time approved in accordance with paragraph 10.(f).

The area which meets the considerations in paragraph 8.(f)(1)(i) may be approved for extended range operations with two-engine aeroplanes.

(2) *Flight Release Limitation*

The flight release limitation should specify the maximum diversion time from a suitable aerodrome for which an operator can conduct a particular extended range operation. The maximum diversion time at the approved one-engine-inoperative cruise speed (under standard conditions in still air) should not be any greater than the value established by paragraph 10.(f)(1)(i).

(i) Use of Maximum Diversion Time

The procedures established by the operator should ensure that extended range operation is limited to flight plan routes where the approved

maximum diversion time to suitable aerodromes can be met under standard conditions in still air. Operators should provide for:

(A) Company procedures to state that upon occurrence of an in-flight shutdown of an engine, the pilot should promptly initiate diversion to fly to and land at the nearest aerodrome, in terms of time, determined to be suitable by the flight crew.

(B) A practice to be established such that in the event of a single or multiple primary system failure, the pilot will initiate the diversion procedure to fly to and land at the nearest aerodrome in terms of time, determined to be suitable by the flight crew, unless it has been justified that no substantial degradation of safety results from continuation of the planned flight.

(3) Contingency procedures should not be interpreted in any way which prejudices the final authority and responsibility of the pilot in command for the safe operation of the aeroplane.

(g) *ETOPS Operational Approval Issued by the Appropriate Authority*

(1) An operator's two-engine aeroplane should not be operated on an extended range flight unless authorised by the operator certificate issued by the appropriate Authority (both maintenance and operations).

(2) The operator certificate issued by the appropriate Authority for extended range operations should specifically include provisions covering at least the following:

(i) Definition of the particular airframe-engine combinations, including the current approved CMP standard required for extended range operation as normally identified in the AFM (Paragraph 8.(f));

(ii) authorised area of operation;

(iii) minimum altitudes to be flown along planned and diversionary routes;

(iv) the maximum diversion time, at the approved one-engine-inoperative cruise speed (under standard conditions in still air), that at any point on the route the aeroplane may be from a suitable aerodrome for landing;

(v) aerodromes nominated for use, including alternates, and associated instrument approaches and operating minima;

(vi) the approved maintenance and reliability programme (Appendix 4) for extended range operation including those items specified in the type design approved CMP standard;

(vii) identification of those aeroplanes designated for extended range operation by make and model as well as serial number and registration;

(viii) aeroplane performance reference.

(h) *Validation of Operator ETOPS Maintenance and Operations Capability*

(1) The operator should demonstrate that it has the competence and capability to conduct safely and support adequately the intended operation.

(2) Prior to being granted ETOPS operational approval, the operator should demonstrate that the ETOPS maintenance checks, servicing, and programmes called for in Appendix 4 are being properly conducted at representative departure and destination aerodromes.

(3) The operator should also demonstrate that ETOPS flight release practices, policies, and procedures are established for operations to and from representative departure and destination aerodromes.

(4) The operator should also demonstrate to the Authority, using the specified airframe-engine combination or preferably by use of an approved simulator, that he has the competence and capability to safely conduct and adequately support the intended operation. The following emergency conditions should be demonstrated during the validation flight unless successful demonstration of these conditions has previously been carried out in an approved simulator:

(i) total loss of thrust of one engine, (simulated, in the aeroplane, by setting zero thrust on the simulated failed engine);

(ii) total loss of normal generated electrical power;

(iii) any other condition considered to be equivalent in airworthiness, crew work-load or performance risk.

(i) *Extended Range Operations Approval*

Following a type design approval for extended range operations in accordance with paragraph 8 and satisfactory application of the criteria in paragraphs 9 and 10 and prior to the issuance by the appropriate Authority of the ETOPS approval, the operator's application and supporting data should be forwarded to the appropriate Authority for review and concurrence. Following the review and concurrence by the appropriate Authority, the operational validation flight should be conducted in accordance with any additional guidance specified in the review and concurrence. When the operational validation flight has been evaluated and found acceptable, an applicant may be authorised to conduct extended range operation with the specified airframe-engine combination. Approval to conduct ETOPS is made by the issuance of the operator certificate by the appropriate Authority containing appropriate limitations.

(j) *Criteria for Operations above 120 minutes and up to 180 minutes*

Each operator requesting Approval to conduct extended range operations beyond 120 minutes should have approximately 12 consecutive months of operational in-service experience with the specified ETOPS configured airframe-engine combination in the

conduct of 120 minute operations. The amount of service experience may be increased or decreased after a review of operator's experience taking into account all factors including the number of sectors. Prior to approval, the operator's capability to conduct operations and implement effective ETOPS programmes in accordance with the criteria detailed in paragraph 10 will be examined. The record of the operator in conducting its 120 minute programme will be considered when granting Approvals beyond 120 minutes diversion time. These operators should also demonstrate the additional capabilities discussed in this paragraph. Approval will be given on a case-by-case basis for an increase to their area of operation beyond 120 minutes. The area of operation will be defined by a maximum diversion time of 180 minutes to an adequate aerodrome at approved one-engine-inoperative cruise speed (under standard conditions in still air). The release limitation will be a maximum diversion time of 180 minutes to a suitable aerodrome at the approved one-engine-inoperative speed (under standard conditions in still air).

(1) *Release Considerations*

(i) Minimum Equipment List (MEL)
The MEL should reflect adequate levels of primary system redundancy to support 180 minutes (still air) operations. The systems listed in paragraph 10.(d)(2)(i) through (xvi) should be considered.

(ii) Weather

An operator should substantiate that the weather information system which it utilises can be relied upon to forecast terminal and en-route weather with a reasonable degree of accuracy and reliability in the proposed area of operation.

(iii) Fuel

The critical fuel scenario should also consider fuel required for all-engine-operations at 10 000 feet or above 10 000 feet if the aeroplane is equipped with sufficient supplemental oxygen.

(2) Flight Planning

The effects of wind and temperature at the one-engine-inoperative cruise altitude should be accounted for in the calculation of equal-time point. In addition, the operator's programme should provide flight crews with information on adequate aerodromes appropriate to the route to be flown which are not forecast to meet Appendix 3 en-route alternate weather minima. Aerodrome facility information and other appropriate planning data concerning these aerodromes should be provided to flight crews for use when executing a diversion.

(i) Crew Training and Evaluation

If standby sources of electrical power significantly degrade cockpit instrumentation to the pilots, then approved training, that simulates an

instrument approach with the standby generator as the sole power source, should be conducted during initial and recurrent training.

(ii) Contingency Procedures

Flight crews should be provided with detailed initial and recurrent training that emphasises established contingency procedures, for each area of operation intended to be used.

(iii) Diversion Decision Making

Special initial and recurrent training to prepare flight crews to evaluate probable propulsion and airframe systems failures should be conducted. The goal of this training should be to establish crew competency in dealing with the most probable operating contingencies.

Note: Although already required for maximum diversion time between 60 and 120 minutes under standard conditions in still air, the requirements of paragraph 10.(j)(2) are emphasised for maximum diversion time beyond 120 minutes.

(iv) Specific instruction should be included in the company operational procedures so that paragraph 10.(d)(5)(iv) is applied, with the additional proviso that an alternate should be selected that is within 180 minutes maximum diversion time, at the approved one-engine-inoperative speed (under standard conditions in still air).

(3) *Equipment*

(i) VHF/HF, Data Link where available

Operators should consider enhancements to their operational control system as soon as they become feasible.

(ii) Automated System Monitoring

The provision of automated aeroplane system status monitoring should be considered in order to enhance the flight crew's ability to make timely diversion decisions.

11 CONTINUING SURVEILLANCE

The fleet average In Flight Shut Down (IFSD) rate for the specified airframe-engine combination will continue to be monitored in accordance with Appendices 1 and 4. As with all other operations, the appropriate Authority should also monitor all aspects of the extended range operations that it has authorised to ensure that the levels of reliability achieved in extended range operations remain at the necessary levels as provided in Appendix 1, and that the operation continues to be conducted safely. In the event that an acceptable level of reliability is not maintained, if significant adverse trends

exist, or if significant deficiencies are detected in the type design or the conduct of the ETOPS operation, then the appropriate Authority should initiate a special evaluation, impose operational restrictions, if necessary, and stipulate corrective action for the operator to adopt in order to resolve the problems in a timely manner. The appropriate Authority should alert the Certification Authority when a special evaluation is initiated and provide for their participation.

APPENDIX 1. PROPULSION SYSTEM RELIABILITY ASSESSMENT

ASSESSMENT PROCESS

To establish whether a particular airframe-engine combination has satisfied the propulsion systems reliability requirements for extended range operation, an assessment will be made by the Authority, using all pertinent propulsion system data. To accomplish the assessment, the Authority will need world fleet data, and data from various sources (the operator, the engine manufacturer and the aeroplane manufacturer) which should be extensive enough and of sufficient maturity to enable the Authority to assess with a high level of confidence, using engineering and operational judgement and standard statistical methods where appropriate, that the risk of total power loss from independent causes is sufficiently low. The Authority will state whether or not the current propulsion system reliability of a particular airframe-engine combination satisfies the relevant criteria. Included in the statement, if the operation is approved, will be the engine build standard, propulsion system configuration, operating condition and limitations required to qualify the propulsion system as suitable for extended range operation. If an approved engine CMP is maintained by the responsible engine Authority and is duly referenced on the engine Type Certificate Data Sheet, then this shall be made available to the Authority conducting the aeroplane propulsion system reliability assessment. Such a CMP shall be produced taking into account all the requirements of paragraphs 8 and 9 and should be incorporated or referenced in the aeroplane CMP.

(a) *Service Experience*

When considering the acceptability of a propulsion system for extended range operation, maturity should be assessed not only in terms of total fleet hours but also take account of fleet leader time over a calendar time but, also to the extent to which test data and design experience can be used as an alternative. There are two extremes in the ETOPS process with respect to maturity; one is the demonstration of stable reliability by the accumulation of service experience and the other is by an agreed design and test programme between the manufacturers and authorities. The extent to which a propulsion system is a derivative of previous ETOPS-rated systems is also a factor of the level of maturity. There is justification for the view that modern propulsion systems achieve a stable reliability level by 100 000 hours for new types and 50 000 hours for derivatives. 3 000 to 4 000 hours is considered to be the necessary time in service for a specific unit to indicate problem areas. Normally, the service experience will be:

(1) For new propulsion systems: 100 000 hours and 12 months service. Where experience on another aeroplane is applicable, a significant portion of the 100 000 hours should normally be obtained on the candidate aeroplane. On a case-by-case basis, relevant test and design experience, and maximum diversion time requested, could be taken into account when arriving at the in-service experience required.

(2) For derivative propulsion systems: 50 000 hours and 12 months service. These values may vary according to the degree of commonality. To this end in determining the derivative status of a propulsion system, consideration should be given to technical criteria referring to the commonality with previous ETOPS-rated engines. Prime areas of concern include:

(i) Turbomachinery

(ii) Controls and accessories and control logic

(iii) Configuration hardware (piping, cables etc.)

(iv) Aircraft to engine interfaces and interaction

(A) Fire

(B) Thrust reverser

(C) Avionics

(D) etc.

The extent to which the in-service experience might be reduced would depend upon the degree of commonality with previous ETOPS-rated engines using the above criteria, and would be decided on a case-by-case basis. Also on a case-by-case basis, relevant test and design experience and maximum diversion time requested, could be taken into account when arriving at the in-service experience required. Thus, the required experience to demonstrate propulsion system reliability should be determined by

(i) The extent to which previous service experience of common ETOPS-rated propulsion systems can be considered.

(ii) To what extent compensating factors such as design similarity and test evidence can be used.

(iii) The two preceding considerations would then determine the amount of service experience needed for a particular propulsion system proposed for ETOPS.

These considerations would be made on a case-by-case basis and would need to provide a demonstrated level of propulsion system reliability in terms of in flight shut down IFSD rate of the order of 0·05 per 1 000 hours, as is necessary also for new propulsion systems.

(b) *Data Required for the Assessment*

(1) A list of all engine shutdown events, both ground and inflight, for all causes (excluding normal training events) including flameout. The list should provide the following for each event:
(i) date;

(ii) airline;

(ii) aeroplane and engine identification (model and serial number);

(iv) power-unit configuration and modification history;

(v) engine position;

(vi) symptoms leading up to the event, phase of flight or ground operation;

(vii) weather/environmental conditions and reason for shutdown and any comment regarding engine restart potential.

(2) All occurrences where the intended thrust level was not achieved, or where crew action was taken to reduce thrust below the normal level, for whatever reason:

(3) Unscheduled engine removals/shop visit rates;

(4) Total engine hours and aeroplane cycles;

(5) All events should be considered to determine their effects on ETOPS operations;

(6) Additional data as required.

(7) The Authority will also consider relevant design and test data.

(c) *Risk Management and Risk Model*

Propulsion systems approved for extended range operation must be sufficiently reliable to assure that defined safety targets are achieved. A review of information for modern fixed wing jet powered aircraft shows that the rate of fatal accidents for all causes is in the order of $0{\cdot}3 \times 10^{-6}$ per flying hour. The reliability of aeroplane types approved for extended range operation should be such that they achieve at least as good an accident record as equivalent technology equipment. The overall target of $0{\cdot}3 \times 10^{-6}$ per flying hour has therefore been chosen as the all-causes safety target. When considering safety targets, an accepted practice is to allocate appropriate portions of the total to the various potential contributing factors. By applying this practice to the overall target of $0{\cdot}3x10^{-6}$ per flying hour, in the proportions previously considered appropriate, the probability of a catastrophic accident due to complete loss of thrust from independent causes must be no worse than $0{\cdot}3 \times 10^{-8}$ per flying hour. Propulsion system related accidents may result from independent cause events but, based on historical evidence, result primarily from events such as uncontained engine failure events, common cause events, engine failure plus crew error events, human error related events and other. The majority of these factors are not specifically exclusive to ETOPS.

Using an expression developed by ICAO, (ref. AN-WP/5593 dated 15/2/84) for the calculation of engine in-flight shutdown rate, together with the above safety objective and accident statistics, a relationship between target engine in-flight shutdown rate for all independent causes and maximum diversion time has been derived. This is shown in Figure 1. In order that type design approval may be granted for extended operation range, it will be necessary to satisfy the Authority that after application of the corrective actions identified during the engineering assessment (see Appendix 1, paragraph 1.(d), the target engine in-flight shutdown rates will be achieved. This will provide assurance that the probability objective for loss of all thrust due to independent causes will be met.

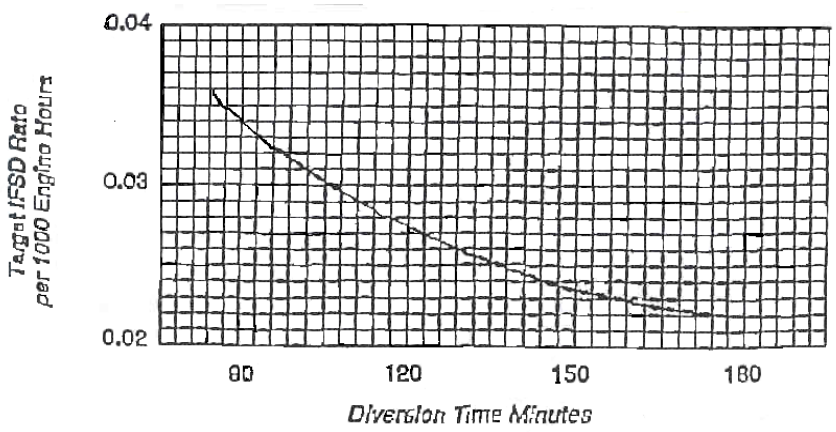

Figure 1: Target IFSD Rate versus Diversion Time

(d) *Engineering Assessment*

(1) There are maintenance programmes, engine on-wing health monitoring programmes, and the promptness and completeness in incorporating engine service bulletins, etc., that influence an operator's ability to maintain a level of reliability. The data and information required will form a basis from which a world-fleet engine shutdown rate will be established for use in determining whether a particular airframe-engine combination complies with criteria for extended range operation.

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

(i) The type of propulsion system, previous experience, whether the power-unit is new or a derivative of an existing model, and the operating thrust level to be used after one engine shutdown.

(ii) The trends in the cumulative twelve month rolling average, updated quarterly, of in-flight shutdown rates versus propulsion system flight hours and cycles.

(iii) The demonstrated effect of corrective modifications, maintenance, etc. on the possible future reliability of the propulsion system.

(iv) Maintenance actions recommended and performance and their effect on propulsion system and APU failure rates.

(v) The accumulation of operational experience which covers the range of environmental conditions likely to be encountered.

(vi) Intended maximum flight duration, and maximum diversion in the ETOPS segment, used in the extended range operation under consideration.

(3) Engineering judgement will be used in the analysis of paragraph 1.(d)(2) such that the potential improvement in reliability, following the introduction of corrective actions identified during the analysis, can be quantified.

(4) The resultant predicted reliability level and the criteria developed in accordance with paragraph 1.c will together be used to determine the maximum diversion time for which the particular airframe-engine combination qualifies.

(5) The type design standard for type approval of the airframe-engine combination for extended range operations will include all modifications and maintenance actions for which full or partial credit is taken in paragraph 1.(d)(3) and other such actions required by the Authority to enhance reliability. The schedule for incorporation of type design standard items should normally be established in the Configuration Maintenance Procedures (CMP) for example in terms of calendar time, hours or cycles.

(6) When a foreign manufacturer's and/or operator's data are evaluated, the respective foreign Airworthiness Authority will be offered the opportunity to participate in the assessment.

(7) Propulsion System Reliability Assessment Board (PSRAB) Findings. Once an assessment has been completed and the PSRAB has documented its findings, the Authority will declare whether or not the particular combination satisfies the relevant considerations of this CAAP. Items recommended to qualify the propulsion system, such as maintenance requirements and limitations will be included in the Assessment Report (paragraph 8.(e)).

(8) In order to establish that the predicted propulsion system reliability level is achieved, and subsequently maintained, the aircraft manufacturer should submit to the Authority an assessment of the reliability of the propulsion system on a quarterly basis. The assessment should concentrate on the ETOPS configured fleet and should include ETOPS related events from the non-configured fleet of the subject airframe-engine combination, and from other combinations utilising a related engine model.

(e) *Continuing Airworthiness*

The Authority will periodically review its original findings. In addition, the Authority document containing the CMP standard will be revised as necessary. The periodic meetings of the ETOPS Reliability Tracking Board prescribed in this CAAP are normally frequent at the start of the assessment of a new product, the periodicity is adjusted by the Authority upon accumulation of substantial service experience if there is evidence that the reliability of the product is sufficiently stable. The periodic meetings of the board are discontinued once an ETOPS product or family of products has been declared mature by the Authority.

(1) *Mature ETOPS products*

A family of ETOPS products with a high degree of similarity is considered as mature once:

(i) The product family has accumulated at least 250 000 flight hours for an aircraft family or 500 000 operating hours for an engine family;

(ii) The product family has accumulated service experience covering a comprehensive spectrum of operating conditions (e.g. cold, hot, humid);

(iii) Each ETOPS approved model or variant in the family has achieved the reliability objectives for ETOPS and has remained stable at or below the objectives fleet-wide for at least two years;

New models or significant design changes may not be considered mature until they have individually satisfied the condition of paragraph (i) here-before. The Reliability Tracking Board Chairman and the Project Certification Manager make the determination of when a product or a product family is considered mature.

(2) *Surveillance of mature ETOPS products*

The Manufacturer of an ETOPS product which the Authority has found mature should institute a process to monitor the reliability of the product in accordance with the objectives defined in Appendix 1 and 2 of this CAAP. In case of occurrence of an event or a series of events or a statistical trend that implies a deviation of the reliability of the ETOPS fleet or a portion of the ETOPS fleet (e.g. one model or a range of serial numbers) above the limits specified for ETOPS in this CAAP, the Manufacturer must:

(i) Inform the Authority and define a means to restore the reliability through a Minor Revision of the CMP, with a compliance schedule to be agreed with the Authority if the situation has no immediate safety impact;

(ii) Inform the Authority and propose an ad-hoc follow-up by the Authority until the concern has been alleviated or confirmed if the situation requires further assessment;

(iii) Inform the Authority and propose the necessary corrective action(s) to be mandated by the Authority through an AD if a direct safety concern exists.

In the absence of a specific event or trend requiring action, the Manufacturer must provide the Authority with the basic statistical indicators prescribed in Appendix 1 and 2 of this CAAP on a yearly basis.

(3) *Design Organisation Approval*

Manufacturers of products approved for ETOPS must hold a Design Organisation Approval (DOA) conforming to IR 21. Their approved Design Organisation Manual (DOM) must contain appropriate organisation and procedures covering the tasks and responsibilities of this CAAP.

Foreign manufacturers not approved as JAA-DOA must present an equivalent organisation and procedures that satisfies the intent of this paragraph. FAA DER system is considered acceptable.

(4) *Minor Revision of the ETOPS CMP Document*

A Minor Revision of the ETOPS CMP document is one that contains only editorial adjustments, configurations, maintenance and procedures equivalent to those already approved by the Authority or new reliability improvements which have no immediate impact on the safety of ETOPS flights and are introduced as a means to control the continued compliance with the reliability objectives of ETOPS. Minor revisions of the ETOPS CMP Document may be approved by designated personnel of the Manufacturer under the provisions of its approved DOM.

Foreign manufacturers not approved as JAA-DOA who operate under the FAA DER system may use their DER to approve Minor Revisions of the CMP.

APPENDIX 2. AIRCRAFT SYSTEMS RELIABILITY ASSESSMENT

ASSESSMENT PROCESS

The intent of this Appendix is to provide additional clarification to paragraphs 8(b), 8(c)(1) and 7(f)(4). Airframe systems are required to show compliance with CS 25.1309. To establish whether a particular airframe-engine combination has satisfied the reliability requirements concerning the aircraft systems for extended range operations an assessment will be made by the Authority, using all pertinent systems data provided by the applicant. To accomplish this assessment the Authority will need world fleet data, and data from various sources (the operators, the equipment manufacturers, and the aeroplane manufacturer). This data should be extensive enough and of sufficient maturity to enable the Authority to assess with a high level of confidence, that the risk of systems failures during a normal ETOPS flight or a diversion, is sufficiently low in direct relationship with the consequence of such failure conditions, under the operational environment of ETOPS missions. The Authority will declare whether or not the current system reliability of a particular airframe-engine combination satisfies the relevant criteria. Included in the declaration will be the airframe build standard, systems configuration, operating conditions and limitations required to qualify the ETOPS significant systems as suitable for extended range operations.

(a) *ETOPS Significant Systems*

(1) An ETOPS significant system is:

(i) A system for which the fail-safe redundancy characteristics are directly linked to the number of engines, e.g. hydraulic system, pneumatic system, electrical system.

(ii) A system that may affect the proper functioning of the engines to the extent that it could result in an inflight shutdown or uncommanded loss of thrust, e.g. fuel system, thrust reverser or engine control or indicating system, engine fire detection system.

(iii) A system which contributes significantly to the safety of flight and a diversion with one engine inoperative, such as back-up systems used in case of additional failure during the diversion. These include back-up or emergency generator, APU or systems essential for maintaining the ability to cope with prolonged operation at single engine altitudes, such as anti-icing systems.

(iv) A system for which certain failure conditions may reduce the safety of a diversion, e.g. navigation, communication, equipment cooling, time limited cargo fire suppression, oxygen system.

(2) The list of ETOPS significant systems should be agreed with the Authority.

(b) *Reliability Assessment for Systems*

The reliability assessment for systems must determine which systems are significant to ETOPS and assure that the reliability of such systems is sufficient in direct relationship with the consequences of their potential malfunctions during ETOPS missions. The

assessment also requires a review of the Systems Safety Assessment (SSA) established in compliance with AMC 25.1309 and specific ETOPS requirements in this CAAP (e.g., loss of cabin pressurisation during Single Engine Operation), to take into account the particular conditions and requirements applicable to ETOPS missions. In order to achieve the level of confidence intended for ETOPS, the analytical assessment in the SSA must be confirmed by statistical data from a sufficient data base of directly applicable service experience and by an engineering assessment of the service experience of the airframe systems under review. Statistical indicators (MTBF/MTBUR) and engineering judgement applied to the individual events must be used to evaluate the maturity and the reliability of all ETOPS significant systems.

(c) *Analytical Assessment*

The SSA conducted in accordance with CS 25.1309 of all ETOPS significant systems shall be reviewed as follows:

(1) Conduct a (supplemental) Functional Hazard Assessment (FHA) considering the ETOPS missions. In determining the effect of a failure condition during an ETOPS mission, the following should also be reviewed:

(i) Crew workload over a prolonged period of time

(ii) Operating conditions at single engine altitude

(iii) Lesser crew familiarity with the procedures and conditions to fly to and land at diversion airfields.

(2) Introduce any additional failure scenario/objectives necessary to comply with this CAAP.

(3) Consider maximum ETOPS flight duration and maximum ETOPS diversion time for all probability calculations. (The probability calculations for those systems that cannot affect the proper functioning of the engines or systems where fail safe/redundancy is not affected by the number of engines, but which could cause a diversion or contribute to the safety of a diversion, may be based on average fleet risk mission time for ETOPS operated aircraft, assuming a maximum diversion time.

(Note - not average risk mission time for whole fleet.)

(4) Consider effects of prolonged time and single engine altitude in terms of continued operation of remaining systems following failures.

(5) Specific ETOPS maintenance tasks and/or intervals or specific ETOPS flight procedures necessary to attain the safety objectives shall be included in the appropriate approved document (e.g. CMP document, MMEL).

(d) *Service Experience/Systems Safety Assessment (SSA)*

When considering the acceptability of airframe systems for extended range operations, maturity should be assessed in terms of the maturity of the technology being used and the maturity of the particular design under review. In performing the SSA's particular account will be taken of the following:

(1) For equipment identical or close to equipment used on other aircraft, the SSA failure rates will be validated by in-service experience. The amount of service experience (either direct or related) shall be indicated for each equipment of an ETOPS significant system. Where related service experience is used to validate failure modes and rates, an analysis shall be produced to show the validity of the service experience. In particular, if the same equipment is used on a different aircraft type, it shall be shown that there is no difference in operating conditions (vibrations, pressure, temperature) or that these differences do not adversely affect the failure modes and rates. If service experience on similar equipment on other aircraft is claimed to be applicable an analysis shall be produced substantiating the reliability figures used on the quantitative analysis. This substantiation analysis should include details of the differences between the similar and new equipment, details of the service experience of the similar equipment and details of any "lessons learnt" modifications introduced and included in the new equipment. For certain equipment, (e.g., IDGs, TRUs, bleeds, emergency generator) this analysis may have to be backed up by tests. This shall be agreed with the Authority.

(2) For new or substantially modified equipment, account will be taken in the SSA for the lack of validation of the failure rates by service experience. A study should be conducted to determine the sensitivity of the assumed SSA failure condition probabilities to the failure rates of that equipment. Should a failure case probability be sensitive to this equipment failure rate and close to the required safety objective, particular provision precautions may be applied (e.g. temporary despatch restrictions, inspections, maintenance procedures, crew procedures ...) to account for the uncertainty until the failure rate has been appropriately validated by service experience.

(3) In order to confirm that the predicted system reliability level is achieved and maintained, the aircraft manufacturer should monitor the reliability of airframe (ETOPS significant) systems after entry into service. The manufacturer should submit a report to the Authority initially on a quarterly basis (for the first year of operation) and thereafter on a periodic basis and for a time to be agreed with the Authority (see 7.(f)(4) and 8.(g)(3)). The monitoring task should include ETOPS significant events from both the ETOPS and non-ETOPS fleet of the subject family of airframes. This additional reliability monitoring is required only for those systems that could effect the proper functioning of the engines or systems where the fail-safe/redundancy is affected by the number of engines and back-up systems used in the case of additional failure during the diversion.

Note: See also Appendix 1 paragraph (e) Continuing Airworthiness for aircraft systems.

APPENDIX 3. SUITABLE EN-ROUTE ALTERNATE AERODROMES

1. GENERAL

(a) One of the distinguishing features of two-engine extended range operations is the concept of a suitable en-route alternate aerodrome being available to which an aeroplane can divert after a single failure or failure combinations which require a diversion. Whereas most two-engine aeroplanes operate in an environment where there is usually a choice of diversion aerodromes available, the extended range 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.

(b) It is, therefore, important that any aerodrome designated as an en-route alternate has the capabilities, services and facilities to support safely 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 completed safely with one propulsion system and/or airframe systems inoperative.

(c) As well as satisfying the ICAO Annex 6 requirements in relation to crew qualification for operations on such routes, operators should show that these facilities and services specified are available for the proposed operations.

2. SUITABLE AERODROME SELECTION

For an aerodrome to be suitable for the purpose of this CAAP, it should have the capabilities, services, a minimum of ICAO category 4, or the relevant aeroplane category if lower, Rescue and Fire Fighting Services (RFFS) and facilities necessary to designate it as an adequate aerodrome, (for RFFS not located on the aerodrome; capability of meeting the aeroplane within 30 minutes notice) and have weather and field conditions at the time of that particular operation which provide a high assurance that an approach and landing can be safely completed with one propulsion system and/or airframe systems inoperative, in the event that a diversion to the en-route alternate becomes necessary. Due to the natural variability of weather conditions with time, as well as the need to determine the suitability of a particular en-route aerodrome prior to departure, the en-route alternate weather minima for planning purposes are generally higher than the weather minima necessary to initiate an instrument approach. This is necessary to assure that the instrument approach can be conducted safely if the flight has to divert to the alternate aerodrome. Additionally, since the visual reference necessary to safely complete an approach and landing is determined, among other things, by the accuracy with which the aeroplane can be controlled along the approach path by reference to instrument aids, as well as by the tasks the pilot is required to accomplish to manoeuvre the aeroplane so as to complete the landing, the weather minima for non-precision approaches are generally higher than for precision approaches.

3. STANDARD EN-ROUTE ALTERNATE AERODROME PRE-DEPARTURE WEATHER MINIMA

The following are established for flight planning and release purposes with two-engine aeroplanes in extended range operations. A particular aerodrome may be considered a suitable aerodrome for

flight planning and release purposes for extended range operation if it meets the criteria of paragraph 3 of this Appendix and has one of the following combinations of instrument approach capabilities and en-route alternate aerodrome weather minima at the time of the particular operation. An operator should include in his Operations Manual either Table 1 or Table 2, but not a combination of both, for use in determining the operating minima at the planned en-route alternate aerodrome.

Table 1 Planning minima - ETOPS

Approach Facility Configuration	Alternate Airfield Ceiling	Weather Minima Visibility/RVR
For aerodromes with at least one operational navigation facility, providing a precision or non-precision runway approach procedure or a circling manoeuvre from an instrument approach procedure	A ceiling derived by adding 400 feet to the authorised DH, MDH (DA/MDA) or circling minima	A visibility derived by adding 1 500 meters to the authorised landing minima.
The weather minima below apply at aerodromes which are equipped with precision or non-precision approaches on at least two separate runways (two separate landing surfaces)		
For aerodromes with at least two operational navigation facilities providing a precision or non-precision runway approach procedure to separate suitable runways	A ceiling derived by adding 200 feet to the higher of the authorised DH/MDH (DA/MDA) for the approaches	A visibility derived by adding 800 meters to the higher of the two authorised landing minima

Table 2 Planning minima – ETOPS

Type of Approach	Planning Minima (RVR visibility required & ceiling if applicable)			
	Aerodrome with			
	at least 2 separate approach procedures based on 2 separate aids serving 2 separate runways (see IEM OPS 1.295 (c)(1)(ii))	at least 2 separate approach procedures based on 2 separate aids serving 1 runway	or	at least 1 approach procedure based on 1 aid serving 1 runway
Precision Approach Cat II, III (ILS, MLS)	Precision Approach Cat I Minima	Non-Precision Approach Minima		
Precision Approach Cat I (ILS, MLS)	Non-Precision Approach Minima	Circling minima or, if not available, non-precision approach minima plus 200 ft / 1 000 m		
Non-Precision Approach	The lower of non-precision approach minima plus 200 ft / 1 000 m or circling minima	The higher of circling minima or non-precision approach minima plus 200 ft / 1 000 m		
Circling Approach	Circling minima			

4. EN-ROUTE ALTERNATE AERODROME PRE-DEPARTURE WEATHER MINIMA TAKING ADVANTAGE OF ADVANCED LANDING SYSTEMS

It is recognised that the development of advanced landing systems may lead to certified capability for planned single engine Category II and/or Category III approach and landings. Before advantage of any such capability can be used in the pre-flight selection of an en-route alternate aerodrome the appropriate Authority shall be satisfied that the operator has demonstrated that when an ETOPS aircraft has encountered any failure condition in the airframe and/or propulsion system that would result in a diversion to an en-route alternate aerodrome, subsequent failures during the diversion, that would result in the loss of the capability to safely conduct and complete the Category II/III approach and landing are Improbable. The certificated capability of the airframe-engine combination should be evaluated considering the approved maximum diversion time. Approval of the planned use of these advanced systems to nominate en-route alternate aerodromes will be on a case-by-case basis and will use the table of paragraph 4 of this Appendix.

5. EN-ROUTE ALTERNATE SUITABILITY IN FLIGHT

See paragraphs 10.(d)(5)(iv) and 10.(j)(2)(iv).

APPENDIX 4. ETOPS MAINTENANCE REQUIREMENTS

1. GENERAL

The maintenance programme should contain the standards, guidance and direction necessary to support the intended operations. Maintenance personnel and other personnel involved should be made aware of the special nature of ETOPS and have the knowledge, skills and ability to accomplish the requirements of the programme.

2. ETOPS MAINTENANCE PROGRAMME

The basic maintenance programme for the aeroplane being considered for ETOPS is the continuous airworthiness maintenance schedule currently approved for that operator, for the make and model airframe-engine combination. This schedule should be reviewed to ensure that it provides an adequate basis for development of ETOPS maintenance requirements. These should include maintenance procedures to preclude identical action being applied to multiple similar elements in any ETOPS significant system (e.g., fuel control change on both engines).

(a) ETOPS related tasks should be identified on the operator's routine work forms and related instructions.

(b) ETOPS related procedures, such as involvement of centralised maintenance control, should be clearly defined in the operator's programme.

(c) An ETOPS service check should be developed to verify that the status of the aeroplane and certain critical items are acceptable. This check should be accomplished by an authorised and trained person prior to an ETOPS flight. Such a person may be a member of the flight crew.

(d) Log books should be reviewed and documented, as appropriate, to ensure proper MEL procedures, deferred items and maintenance checks, and that system verification procedures have been properly performed.

3. ETOPS MANUAL

The operator should develop a manual for use by personnel involved in ETOPS. This manual need not include, but should at least reference, the maintenance programme and other requirements described by this Appendix, and clearly indicate where they are located in the operator's manual system. All ETOPS requirements, including supportive programmes, procedures, duties, and responsibilities, should be identified and be subject to revision control. This manual should be submitted to the Authority 30 days before implementation of ETOPS flights. Alternatively, the operator may include this information in existing manuals used by personnel involved in ETOPS.

4. OIL CONSUMPTION PROGRAMME

The operator's oil consumption programme should reflect the manufacturer's recommendations and be sensitive to oil consumption trends. It should consider the amount of oil added at the departing

ETOPS stations with reference to the running average consumption; i.e., the monitoring must be continuous up to, and including, oil added at the ETOPS departure station. If oil analysis is meaningful to this make and model, it should be included in the programme. If the APU is required for ETOPS operation, it should be added to the oil consumption programme.

5. ENGINE CONDITION MONITORING

This programme should describe the parameters to be monitored, method of data collection and corrective action process. The programme should reflect manufacturer's instructions and industry practice. This monitoring will be used to detect deterioration at an early stage to allow for corrective action before safe operation is affected. The programme should 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 temperature) at all approved power levels and expected environmental conditions. Engine margins preserved through this programme should 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.

6. VERIFICATION PROGRAMME AFTER MAINTENANCE

The operator should develop a verification programme or procedures should be established to ensure corrective action following an engine shutdown, primary system failure or adverse trends or any prescribed events which require a verification flight or other action and establish means to assure their accomplishment. A clear description of who must initiate verification actions and the section or group responsible for the determination of what action is necessary should be identified in the programme. Primary systems or conditions requiring verification actions should be described in the operator's ETOPS manual.

7. RELIABILITY PROGRAMME

An ETOPS reliability programme should be developed or the existing reliability programme supplemented. This programme should be designed with early identification and prevention of ETOPS related problems as the primary goal. The programme should be event-orientated and incorporate reporting procedures for significant events detrimental to ETOPS flights. This information should be readily available for use by the operator and Authority to help establish that the reliability level is adequate, and to assess the operator's competence and capability to safely continue ETOPS. The Authority should be notified within 96 hours of events reportable through this programme.

(a) In addition to the items required to be reported by national regulations, the following items should be included:

(i) in-flight shutdowns;

(ii) diversion or turnback;

(iii) uncommanded power changes or surges;

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

(v) problems with systems critical to ETOPS.

(b) The report should identify the following:

(i) aeroplane identification;

(ii) engine identification (make and serial number);

(iii) total time, cycles and time since last shop visit;

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

(v) phase of flight; and

(vi) corrective action.

8. PROPULSION SYSTEM MONITORING

The operator's assessment of propulsion systems reliability for the extended range fleet should be made available to the Authority (with the supporting data) on at least a monthly basis, to ensure that the approved maintenance programme continues to maintain a level of reliability necessary for extended range operation. The assessment should 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 extended range fleet is part of a larger fleet of the same airframe-engine combination, data from the operator's total fleet will be acceptable. However, the reporting requirements of paragraph 7 of this Appendix must still be observed for the extended range fleet. Any adverse sustained trend would require an immediate evaluation to be accomplished by the operator in consultation with the Authority. 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 operator's performance will be reviewed on a case-by-case basis.

9. MAINTENANCE TRAINING

The Maintenance training should focus on the special nature of ETOPS. This programme should be included in the normal maintenance training. The goal of this programme is to ensure that all personnel involved in ETOPS are provided with the necessary training so that the ETOPS maintenance tasks are properly accomplished and to emphasise the special nature of ETOPS maintenance requirements. Qualified maintenance personnel are those that have completed the operator's extended range training programme and have satisfactorily performed extended range tasks under supervision, within the framework of the operator's approved procedures for Personnel Authorisation.

10 ETOPS PARTS CONTROL

The operator should develop a parts control programme with support from the manufacturer, that ensures the proper parts and configuration are maintained for ETOPS. The programme includes verification that parts placed on an ETOPS aeroplane during parts borrowing or pooling

arrangements, as well as those parts used after repair or overhaul, maintain the necessary ETOPS configuration for that aeroplane.

APPENDIX 5. ETOPS CRITERIA FOR 90 MINUTES OR LESS

(Note: 180 min provisions are included in the main text)

1. GENERAL

Paragraphs 10.(a) through 10.(i) of this CAAP detail the criteria for operational approval of extended range operations with a maximum diversion time between 60 and 120 minutes to an en route alternate (at approved single-engine inoperative cruise speed). This appendix serves the function of differentiating the criteria for approval of operations up to 90 minutes diversion time.

2. 90 - MINUTE OPERATION

Since 1976, two-engine aeroplane operations up to 90 minutes diversion time (two engine speed) were approved over Africa, the Indian Ocean, the Bay of Bengal and the North Atlantic using ICAO recommendations of the time and the applicable operational rule. The aeroplanes performing these missions were not designed to meet all the design and reliability criteria now in Paragraphs 8, 9 and Appendix 1 & 2 of this CAAP and were not subjected to the operational approval criteria detailed in Paragraph 10, Appendices 3, 4 and 7 of this CAAP. However, these operations have proven to be safe and successful due to the short duration of the concerned ETOPS sectors, the short diversion time, the favourable operating characteristics of the route and the built-in reliability of the initial product. This experience, along with the ETOPS operational experience gathered since 1985, has led to the development of the 90 minute criteria detailed below. This criteria bridges the gap between the 60 min, non-ETOPS, requirements and the current requirements defined in this CAAP. It defines specifically what needs to be accomplished in order to obtain an operational approval with a maximum diversion time of 90 minutes or less.

3. CRITERIA FOR APPROVAL TO OPERATE UP TO 90 MINUTES

(a) Type Design

Compliance must be shown to all applicable paragraphs. Where relevant, specific 90 min, or less, criteria is denoted directly in the text of paragraphs 8 and Appendix 1.

(b). Operational Approval

Consideration may be given to the approval of extended range operations up to 90-minutes for operators with minimal or no in-service experience with the airframe-engine combination. This determination considers such factors as the proposed area of operations, the operator's demonstrated ability to successfully introduce aeroplanes into operations, the quality of the proposed maintenance and operations programmes.

(1) Maintenance

Maintenance programmes should be instituted which follow the guidance in Appendix 4.

(2) Operations

(i) Operation programmes should be instituted which follow the guidance in paragraphs 10.(d), 10.(e) and 10.(f) and Appendix 3.

(ii) Minimum Equipment List (MEL): Provision of the Master Minimum Equipment List (MMEL), including 90 minute or less "Extended Range" provisos.

APPENDIX 6. RESERVED

APPENDIX 7. REDUCTION OF OPERATOR'S EXPERIENCE

REDUCTION OF OPERATOR'S IN-SERVICE EXPERIENCE REQUIREMENT PRIOR TO THE GRANTING OF AN ETOPS OPERATIONAL APPROVAL ('ACCELERATED ETOPS OPERATIONAL APPROVAL')

A General

The purpose of this appendix is to establish the factors which the Authority may consider in exercising its authority to allow reduction or substitution of operator's in-service experience requirement in granting ETOPS Operational Approval. Paragraph 7 of this CAAP states that "....the concepts for evaluating extended range operations with two-engine aeroplanes....ensures that two-engine aeroplanes are consistent with the level of safety required for current extended range operations with three and four-engine turbine powered aeroplanes without unnecessarily restricting operation". It is apparent that the excellent propulsion related safety record of two-engine aeroplanes has not only been maintained, but potentially enhanced, by the process related provisions associated with ETOPS Type Design and Operational Approvals. Further, currently available data shows that these processes related benefits are achievable without extensive in-service experience. Therefore, reduction or elimination of in-service experience requirements may be possible when the operator shows to the Authority that adequate and validated ETOPS processes are in place. The Accelerated ETOPS Operational Approval Programme with reduced in-service experience does not imply that any reduction of existing levels of safety should be tolerated but rather acknowledges that an operator may be able to satisfy the objectives of this CAAP by a variety of means of demonstrating that operator's capability. This Appendix permits an operator to start ETOPS operations when the operator has established that those processes necessary for successful ETOPS operations are in place and are considered to be reliable. This may be achieved by thorough documentation of processes, demonstration on another aeroplane/validation (as described in Paragraph G of this Appendix) or a combination of these.

B Background

When ETOPS requirements were first released in 1985 ETOPS was a new concept, requiring extensive in-service verification of capability to assure the concept was a logical approach. At the time, the Authorities recognised that a reduction in the in-service requirements or substitution of in-service experience, on another aeroplane, would be possible. The ETOPS concept has been successfully applied for close to a decade; ETOPS is now widely employed. The number of ETOPS operators has increased dramatically, and in the North Atlantic US airlines have more twin operations than the number of operations accomplished by three and four engine aeroplanes. ETOPS is now well established. Under the CAAP, an operator is generally required to operate an airframe-engine combination for one (1) year, before being eligible for 120 minute ETOPS; and another one (1) year, at 120 minute ETOPS, before being granted 180 minute ETOPS approval. For example, an operator who currently has 180 minute ETOPS approval on one type of airframe-engine or who is currently operating that route with an older generation three or four engine aeroplane could be required to wait for up to two (2) years for such an approval. Such a requirement creates undue economic burden on operators and may not contribute to safety. Data indicates that compliance with processes has resulted in successful ETOPS operation at earlier than the standard time provided for in the CAAP.

ETOPS operational data indicates that twins have maintained a high degree of reliability due to heightened awareness of specific maintenance, engineering and flight operation process related requirements. Compliance with ETOPS processes is crucial in assuring high levels of reliability of

twins. Data shows that previous experience on an airframe-engine combination prior to operating ETOPS, does not necessarily make a significant difference in the safety of such operations. Commitment to establishment of reliable ETOPS processes has been found to be a much more significant factor. Such commitment, by operators, to ETOPS processes has, from the outset, resulted in operation of twins at a mature level of reliability. ETOPS experience of the past decade shows that a firm commitment by the operator to establish proven ETOPS processes prior to the start of actual ETOPS operations and to maintain that commitment throughout the life of the programme is paramount to ensuring safe and reliable ETOPS operations.

C Definitions

Process:

A process is a series of steps or activities that are accomplished, in a consistent manner, to ensure that a desired result is attained on an ongoing basis. Paragraph D documents ETOPS processes that should be in place to ensure a successful Accelerated ETOPS programme.

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 elements
- Indications of process stability/reliability
- Parameters to validate process and monitor (measure) success
- Duration of necessary evaluation to validate process

(4) Procedure for follow-up in-service monitoring to assure process remains reliable/stable.

Methods of process validation are provided in paragraph G.

D ETOPS Processes

The two-engine airframe-engine combination for which the operator is seeking Accelerated ETOPS Operational Approval must be ETOPS Type Design approved prior to commencing ETOPS. The operator seeking Accelerated ETOPS Operational Approval must demonstrate to the Authority that it has an ETOPS programme in place that addresses the process elements identified in this section. The following are the ETOPS process elements:

(1) Aeroplane/engine compliance to Type Design Build Standard (CMP)

(2) Compliance with the Maintenance Requirements as defined in Paragraph 10 and Appendix 4 of this CAAP:

- Fully developed Maintenance Programme (Appendix 4, paragraph 2) which includes a tracking and control programme.

- ETOPS manual (Appendix 4, paragraph 3) in place.
- A proven Oil Consumption Monitoring Programme. (Appendix 4, paragraph 4)
- A proven Engine Condition Monitoring and Reporting system. (Appendix 4, paragraph 5)
- A proven Plan for Resolution of Aeroplane Discrepancies. (Appendix 4, paragraph 6)
- A proven ETOPS Reliability Programme. (Appendix 4, paragraph 7)
- Propulsion system monitoring programme (Appendix 4, paragraph 8) in place. The operator should establish a programme that results in a high degree of confidence that the propulsion system reliability appropriate to the ETOPS diversion time would be maintained.
- Training and qualifications programme in place for ETOPS maintenance personnel. (Appendix 4, paragraph 9).
- Established ETOPS parts control programme (Appendix 4, paragraph 10)

(3) Compliance with the Flight Operations Programme as defined in Paragraph 10 of this CAAP.

- Proven flight planning and dispatch programmes appropriate to ETOPS.
- Availability of meteorological information and MEL appropriate to ETOPS.
- Initial and recurrent training and checking programme in place for ETOPS flight operations personnel.
- Flight crew and dispatch personnel familiarity assured with the ETOPS routes to be flown; in particular the requirements for, and selection of, en-route alternates.

(4) Documentation of the following elements:

- Technology new to the operator and significant difference in primary and secondary power (engines, electrical, hydraulic and pneumatic) systems between the aeroplanes currently operated and the two-engine aeroplane for which the operator is seeking Accelerated ETOPS Operational Approval.
- The plan to train the flight and maintenance personnel to the differences identified in 1 above.
- The plan to use proven or manufacturer validated Training and Maintenance and Operations Manual procedures relevant to ETOPS for the two-engine aeroplane for which the operator is seeking Accelerated ETOPS Operational Approval.

- Changes to any previously proven or manufacturer validated Training, Maintenance or Operations Manual procedures described above. Depending on the nature of any changes, the operator may be required to provide a plan for validating such changes.

- The validation plan for any additional operator unique training and procedures relevant to ETOPS, if any.

- Details of any ETOPS programme support from the airframe manufacturer, engine manufacturer, other operators or any other outside agency.

- The control procedures when maintenance or flight dispatch support is provided by an outside party as described above.

E Application

Paragraph 10a of this CAAP requires that requests for extended range operations be submitted at least 3 months prior to the start of extended range operations. Normally, the operator should submit an 'Accelerated ETOPS Operational Approval Plan' to the Authority six (6) months before the proposed start of extended range operations. This additional time will permit the Authority to review the documented plans and assure adequate ETOPS processes are in place. The operator's application for Accelerated ETOPS should:

- Define proposed routes and the ETOPS diversion time necessary to support those routes.

- Define processes and related resources being allocated to initiate and sustain ETOPS operations in a manner which demonstrates commitment by management and all personnel involved in ETOPS maintenance and operational support.

- Identify, where required, the plan for establishing compliance with the build standard required for Type Design Approval, e.g. CMP (Configuration, Maintenance and Procedures Document) compliance.

- Document plan for compliance with requirements in Paragraph D.

- Define Review Gates. A Review Gate is a milestone tracking plan to allow for the orderly tracking and documentation of specific requirements of this Appendix. Each Review Gate should be defined in terms of the tasks to be satisfactorily accomplished in order for it to be successfully passed. Items for which the Authority visibility is required or the Authority approval is sought should be included in the Review Gates. Normally, the Review Gate process will start six (6) months before the proposed start of extended range operations and should continue at least six (6) months after the start of extended range operations. Assure that the proven processes comply with the provisions of Paragraph C of this Appendix.

F Operational Approvals

Operational approvals which are granted with reduced in-service experience should be limited to those areas agreed by the Authority at approval of the Accelerated ETOPS Operational Approval

Plan. When an operator wishes to add new areas to the approved list, Authority concurrence is required. Operators will be eligible for ETOPS Operational Approval up to the Type Design Approval limit, provided the operator complies with all the requirements in Paragraph D.

G Process Validation

Paragraph D identifies those process elements that are needed to be proven prior to the start of Accelerated ETOPS. For a process to be considered proven, the process must first be defined. Typically this will include a flow chart showing elements of the process. Roles and responsibilities of the personnel who will be managing this process should be defined including any training requirement. The operator should demonstrate that the process is in place and functions as intended. The operator may accomplish this by thorough documentation and analysis, or by demonstrating on an aeroplane that the process works and consistently provides the intended results. The operator should also show that the feedback loop exists to illustrate need for revision of the process, if required, based on in-service experience. Normally the choice to use, or not to use, demonstration on an aeroplane as a means of validating the process should be left up to the operator. With sufficient preparation and dedication of resources such validation may not be necessary to assure processes should produce acceptable results. However, in any case where the proposed plan to prove the processes is determined by the Authority to be inadequate or the plan does not produce acceptable results, validation of the process in an aeroplane may be required. If any operator is currently operating ETOPS with a different airframe and/or engine combination it may be able to document that it has proven ETOPS processes in place and only minimal further validation may be necessary. It will, however, be necessary to demonstrate that means are in place to assure equivalent results will occur on the aeroplane being proposed for Accelerated ETOPS Operational Approval. The following elements which, while not required, may be useful or beneficial in justifying a reduction in the requirements of ETOPS processes:

Experience with other airframes and/or engines.

(1). Previous ETOPS experience.

(2) Experience with long range, overeater operations with two, three or four engine aeroplanes.

Any experience gained by flight crews, maintenance personnel and flight dispatch personnel while working with other ETOPS approved operators. Process validation may be done in the airframe-engine combination which will be used in Accelerated ETOPS operation or in a different aeroplane type than that for which approval is being sought, including those with three and four engines. A process may be validated by first demonstrating the process produces acceptable results on a different aeroplane type or airframe-engine combination. It should then be necessary to demonstrate that means are in place to assure equivalent results should occur on the aeroplane being proposed for Accelerated ETOPS Operational Approval. Any validation programme should address the following:

- The operator should show that it has considered the impact of the ETOPS validation programme with regard to safety of flight operations.

- The operator should state in its application any policy guidance to personnel involved in the ETOPS process validation programme. Such guidance should clearly state that ETOPS process validation exercises should not be allowed to adversely impact the safety of actual operations especially during periods of abnormal, emergency, or high

cockpit workload operations. It should emphasise that during periods of abnormal or emergency operation or high cockpit workload ETOPS process validation exercises may be terminated.

- The validation scenario should be of sufficient frequency and operational exposure to validate maintenance and operational support systems not validated by other means.

- A means must be established to monitor and report performance with respect to accomplishment of tasks associated with ETOPS process elements. Any recommended changes to ETOPS maintenance and operational process elements should be defined.

Prior to the start of the process validation programme, the following information should be submitted to the Authority:

- Validation periods, including start dates and proposed completion dates.

- Definition of aeroplane to be used in the validation. List should include registration numbers, manufacturer and serial number and model of the airframe and engines.

- Description of the areas of operation (if relevant to validation objectives) proposed for validation and actual operations.

- Definition of designated ETOPS validation routes. The routes should be of duration required to ensure necessary process validation occurs.

Process validation reporting. The operator should compile results of ETOPS process validation. The operator should:

- Document how each element of the ETOPS process was utilised during the validation.

- Document any shortcomings with the process elements and measures in place to correct such shortcomings.

- Document any changes to ETOPS processes which were required after an in-flight shut down (IFSD), unscheduled engine removals, or any other significant operational events.

- Provide periodic Process Validation reports to the Authority. This may be addressed during Review Gates.