NOTICE OF PROPOSED AMENDMENT ("NPA") No 2008-01

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING DECISION No 2003/1/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 17 October 2003 on acceptable means of compliance and guidance material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations ("AMC and GM to Part 21")

AND

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING DECISION No 2003/11/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 5 November 2003 on definitions and abbreviations used in certification specifications for products, parts and appliances («CS-Definitions»)

AND

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING DECISION No 2003/2/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes («CS-25»)

AND

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING DECISION No 2003/9/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for engines («CS-E»)

AND

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING ANNEX I & ANNEX II (AMC to Part M and Part-145) OF DECISION No 2003/19/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 28 November 2003 on acceptable means of compliance and guidance material to Commission Regulation (EC) No 2042/2003 of 20 November 2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks

AND

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY AMENDING DECISION No 2003/12/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY of 5 November 2003 on general acceptable means of compliance for airworthiness of products, parts and appliances («AMC-20»)

"Extended Range Operations with Two-Engined Aeroplanes ETOPS Certification and Operation (AMC 20-6)"

TABLE OF CONTENTS

A. EXPLANATORY NOTE

I. General

1. The purpose of this NPA is to enhance and modernise the airworthiness, continuing airworthiness and operational considerations for applicants seeking approval for extended operations of two-engined aeroplanes and in particular it adds additional requirements for applicants seeking approval for diversion time beyond 180 minutes (which is part of extended range operations of two-engined aeroplanes (twins) or ETOPS) at the approved one-engine inoperative speed from an adequate aerodrome. It also introduces new concepts as 'early ETOPS' and 'accelerated ETOPS'.

2. This NPA does not address the concept of extended range operations for three-engined aeroplanes (tris) and four-engined aeroplanes (quads) (LROPS).

3. The Agency is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[1] which are adopted as "Opinions" (Article 14(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 14(2)).

4. When developing rules, the Agency is bound to following a structured process as required by article 43(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as the "Rulemaking Procedure"[2].

5. This rulemaking activity is included in the Agency's rulemaking programme for 2008. It implements the rulemaking task MDM.001 related to ETOPS.

6. The text of this NPA has been developed by the Agency using the technical material provided with the proposal developed by the Joint Aviation Authorities (JAA) ETOPS/LROPS Ad Hoc Working Group. It is submitted for consultation of all interested parties in accordance with Article 43 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

II. Consultation

1. To achieve optimal consultation, the Agency is publishing the draft Decision of the Executive Director on its internet site. Comments should be provided within 3 months in accordance with Article 6(4) of the Rulemaking Procedure. Comments on this proposal should be submitted by one of the following methods:

CRT:	Send your comments using the Comment-Response Tool (CRT) available at http://hub.easa.europa.eu/crt/

---

[1] Regulation (EC) No 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (*OJ L 240, 7.9.2002, p.1).* Regulation as last amended by Regulation (EC) No 334/2007 *(OJ L 88, 29.3.2007, p. 39).*

[2] Management Board Decision concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("Rulemaking Procedure"), EASA MB/08/07, 13.6.2007.

E-mail: Only in case the use of CRT is prevented by technical problems comments can be submitted by email. In this case problems should be reported to the CRT webmaster and comments sent to NPA@easa.europa.eu.

Correspondence: If you do not have access to internet or e-mail you can send your comments by mail to:
Process Support
Rulemaking Directorate
EASA
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be received by the Agency before 6 June 2008. If received after this deadline they might not be taken into account.

III. Comment response document

1. All comments received in time will be responded to and incorporated in a comment response document (CRD). The CRD will be available on the Agency's website and in the Comment-Response Tool (CRT).

IV. Content of the draft Decisions

1. Regulatory Background

JAA ETOPS/LROPS Ad Hoc Working Group was tasked by the former JAA Regulation Director in 2000 to develop, enhance and modernise the regulatory material applicable to ETOPS operations. Since then, a considerable amount of work was performed by the JAA ETOPS/LROPS Ad Hoc Working Group. The outcome of this work has been the basis for the current proposal.

The following main directions were followed by the working group:

1) Develop criteria for operations of two-engined aeroplanes with diversion times exceeding 180 minutes;
2) Assess the impact of the increase of range of modern two-, three- and four-engined aeroplanes on new long haul routes, in particular in severe climate areas;
3) Re-arrange the provisions of GAI 20x6 (transferred into EASA AMC 20-6) according with the principles of JAR-11 (regulatory vs. advisory material);
4) Re-distribute material in accordance with the new regulatory context of the Basic Regulation;
5) Harmonise with FAA and ICAO; and;
6) Propose a Regulatory Impact Assessment (RIA).

These tasks were completed by the working group and resulted in a report (which was the basis for the former JAA NPA-OPS 40 ETOPS/LROPS) composed of:

1) Amendments to JAR-21 which was the basis for the draft decision amending AMC and GM to Part 21 included in this NPA;

2) Amendments to JAR-25 and JAR-E which were the basis for draft decisions amending CS-25 and CS-E included in this NPA;

3) Draft amendments to JAR-OPS 1 which has been the basis for amending EU-OPS 1[3];

4) Amendments to GAI-20 ACJ 20X which have been the basis for the Amendments to AMC 20-6, included in this NPA:

   a. Airframe and Engine Type design approval considerations;

   b. Operations approval considerations;

   c. Continuing airworthiness approval considerations.

5) RIA.

The initial proposal also included amendments to JAR-21 to refer to ETOPS reporting system requirements for holders of certificates for products, parts and appliances. This proposal has not been included in the current package. The current text of Part 21 (21.A.3) is general and the Agency considers that a specific reference to ETOPS case does not fit in Part 21. However, the GM to Part 21.A.3 has been expanded to make specific reference to ETOPS reporting system, as further described in the proposals for AMC 20-6.

2. The origination of the proposal included in this NPA

During the development period of the proposals under JAA umbrella, various stakeholders expressed their disagreement with the LROPS concept because they considered that there was not any safety justification for such proposal. There were also some disagreements with the requirements for the passenger recovery plan because they considered that this is part of the contract between the passengers and the operators and should not be regulated by the safety rules.

After several discussions between European air transport industry, EASA and CJAA, the JAA ETOPS/LROPS Ad Hoc Working Group was recommended to split the initial proposal (included in JAA NPA-OPS 40 ETOPS/LROPS) into three separate subjects:

1) The extension of the ETOPS diversion time for two-engined aeroplanes (twins) beyond 180 minutes.

2) The extension of the provisions of the ETOPS NPA to three-engined aeroplanes (tris) and four-engined aeroplanes (quads) (LROPS) to be progressed in a separate A-NPA.

3) The selection of alternate aerodromes located in severe climate areas should also be progressed in a separate A-NPA.

[3] EU-OPS 1 EC regulation No 1899/2006 of the European Parliament and of the Council of 12 December 2006 amending Annex III of the Council Regulation (EEC) No 3922/91 on the harmonisation of technical requirements and administrative procedures in the field of civil aviation.

3. The development process

This new direction implied re-working of the existing proposals in order to segregate the material applicable to two-engined aeroplanes from that applicable to tris and quads and to treat the issue of the selection of alternate aerodromes located in severe climate areas in a separate proposal.

The initial JAA NPA-OPS 40 ETOPS/LROPS was re-organised into the following parts:

1) JAA NPA-OPS 40A ETOPS which relates to extension of the ETOPS threshold diversion time of two-engined aeroplanes. While keeping the same general arrangement compatible with the future organisation of the Basic Regulation, JAA NPA-OPS 40A ETOPS was essentially similar to the initial proposal but retaining only the provisions for air operations applicable to two-engined aeroplanes. It included to JAR-OPS 1 and a new AMC OPS 1.246. After the JAA Operational Sectorial Team reviewed and endorsed the NPA-OPS 40A ETOPS at the OST 07-2, the Agency considered that the operational considerations of the new AMC OPS 1.246 were technically mature and that they should be used to enhance chapter 10 of EASA AMC 20-6. It is considered that chapter 10 of AMC 20-6 will be otherwise obsolete and incomplete. Moreover, it has to be noted that the operational considerations included in this NPA will not be re-published within the future EASA NPAs once the legislative proposal for extending EASA Basic Regulation scope to the field of air operations and flight crew licensing has been finished.

2) A-NPA-OPS 40B LROPS which relates to the extension of the ETOPS principles to operation of three- and four-engined aeroplanes LROPS. This A-NPA has been transferred to EASA rulemaking inventory for further processing in the near future.

3) A-NPA-OPS 40C which relates to the selection of alternate aerodromes located in severe climate areas. This A-NPA has also been transferred to EASA rulemaking inventory for further processing in the near future. EASA will study whether this is a health and safety issue which is within EASA's remit.

4) Proposed amendments to AMC and GM to Part 21, Part 145 and Part M which are included in this NPA.

5) Proposed amendments to CS-Definitions, CS-25 and CS-E which are included in this NPA.

6) Proposed amendments to AMC 20-6 which are included in this NPA.

4. Any significant, contentious and/or interface issues

As already mentioned, there are two contentious issues that were discussed at length during the rulemaking development:

1) The need to develop a recovery plan on alternate aerodromes classified as Severe Climate Aerodromes, which was considered to be a health and safety issue that is

outside EASA's remit. It was considered to be a responsibility of the operators as part of the air transport contract;

2) The LROPS concept. Due to operators concerns, it will be only an Advance-NPA.

The difficulties faced in dissolving the concerns expressed and in achieving a consensus between the different parties, led to the various rulemaking proposals which have not been kept in this NPA.

5. Harmonisation with ICAO

The ICAO Operations Panel (OPSP), after being tasked by Air Navigation Commission (ANC), made a first consideration about the ETOPS requirements during the OPSP/6 meeting in 2003. Subsequently, in its review of the OPSP/6 recommendations, the ANC determined that the proposals were not sufficiently mature and directed OPSP to continue its work on the issue. Work progressed through the Extended Range Sub-Group (ERSG). The ERSG presented its recommendations during OPSP Working Group meeting in October 2005. The agreed proposal was presented to OPSP/7 meeting in May 2006 where it was decided that the recommendations were mature enough to go to the ICAO ANC for decision.

The proposed amendments include:

1) Amendment to Annex 6 Part I;
2) Amendments to Annex 8 ;
3) Amendments to ICAO Airworthiness Manual (DOC 9760);
4) Provision for Extended/Long Range operations of aeroplanes with two and more engines; and;
5) Passengers' recovery plans for selection of alternative aerodromes located in severe climate areas.

The present NPA complies with the proposals in draft report presented at ICAO OPS Panel No 7, as revised on 11/05/06, for two-engined aeroplanes excluding the passengers' recovery plan provisions.

It should be noted that the European proposal has elected not to designate particular ETOPS "designated" areas in the ETOPS definition as it is recommended by ICAO.

6. Harmonisation with other authorities or organisations

The FAA published their final rule on 'Extended Operations (ETOPS) of Multi-engined Aeroplanes' in January 2007.

The present NPA is not fully harmonised with the FAA final rules. Two main areas of non-harmonisation deserve to be highlighted:

- This NPA does not address the issue of three- and four-engined aeroplanes.
- This NPA does not include passengers' recovery plans for severe climate areas.

- This NPA use the term ETOPS for the extended operations of aeroplanes with two engines only. The FAA use the term ETOPS also for extended operations of aeroplanes with more than two engines

In addition, there are some other issues that are not harmonised with the FAA final rules. This is further explained in Annex 7 to RIA.

7. Record of the parties which were involved in the group of experts during the development process

The experts that were involved during the development process come from different stakeholders:

- Airline associations (AEA, ERA, IACA);
- Airline representatives;
- (S) TC holder s (Type Certificate holders and Supplemental Type Certificate holders);
- Airline Pilot Associations;
- Authorities (JAA, EASA and non-JAA);
- Passenger associations.

8. Record of the parties which were consulted during the development process

The former NPA-OPS 40A was presented to the JAA Operational Sectorial Team (OST) several times. In particular at the OST 06-5 in November 2006, further issues were raised by Airbus, Boeing, AEA and GAMA. The OST tasked the JAA ETOPS/LROPS Ad Hoc Working Group to consider these comments and to amend the proposal for final endorsement by the OST.

Due to the transition process between JAA and EASA (EASA took over JAA rulemaking activities the JAA rulemaking tasks 01/01/07 in accordance with the FUJA Report), the amended proposal was not presented at the first OST meeting that took place last March 2007 but at the OST 07-2 that took place in May 2007. The OST endorsed then the technical proposal.

V. Regulatory Impact Assessment

The regulatory impact assessment (RIA) was developed by the JAA ETOPS/LROPS Ad Hoc Working Group for the initial package (proposal for ETOPS rules including amendments to airworthiness, continuing airworthiness and operations).

The RIA was developed in the year 2004 and therefore, some of the air traffic forecast data provided in the annexes to RIA may not be up to date.

The regulatory impact assessment has been divided into two parts as followed:

1) **Part 1:** Two-Engined commercial air transportation of large aeroplanes with a maximum approved passenger seating configuration of 20 or more, or with a maximum take-off mass of 45360 kg or more, with a diversion time greater than 60 minutes at the approved one-engine-inoperative

speed (under standard conditions in still air) from an adequate aerodrome.

2) **Part 2:** Two-Engined aeroplanes with a maximum approved passenger seating configuration of 19 or less and a maximum take-off mass less than 45360 kg, with a diversion time greater than 180 minutes at the approved one-engine-inoperative speed (under standard conditions in still air) from an adequate aerodrome.

For each RIA part all aspects (Design, Operations and Maintenance) will be assessed. However, as already explained above, elements provided for the assessment of the passengers' recovery plan and for LROPS requirements have been excluded from this RIA.

The FAA cost-benefit evaluation of their previous Notice of Proposed Rulemaking (NPRM) to Codify and Expand Existing ETOPS Program, that was published on November 14, 2003 (68 FR 64730), can be considered as background information (for two-engined aeroplanes only).

It has to be highlighted that the new proposals for ETOPS include:

1) Alleviation on fuel scenario;
2) More flexibility on one engine-out speed;
3) Deletion of the 180 minutes threshold diversion time;
4) Revised flight planning minima, which are considered to have a positive impact on the economic aspect without reducing the level of safety of such operations.

The complete RIA is included as Appendix C to this NPA.

B. DRAFT OPINION(S) AND/OR DECISION(S).

The following explanation must be given before the actual draft Decision text. This explanation does not apply to Opinions.

The text of the amendment is arranged to show deleted text, new text or new paragraph as shown below:

1. deleted text is shown with a strike through: ~~deleted~~
2. new text is highlighted with grey shading: new
3. ….

Indicates that remaining text is unchanged in front of or following the reflected amendment.

….

I. Draft Decision amending AMC and GM to Part 21:

Introduce new subparagraph as follows:

AMC 21A.3(a) Collection, investigation and analysis of data related to ETOPS significant occurrences

(a) Holders of a type-certificate, restricted type-certificate, supplemental type-certificate or any other relevant approval deemed to have been issued under Part 21 and which includes extended range operation with two-engined aeroplane (ETOPS) capability should implement a specific tracking, reporting and resolution system for ETOPS significant occurrences, suitable to ensure the initial and continued fleet compliance with the applicable ETOPS reliability objectives. This system should be part of the system for collection, investigation and analysis of data required by 21.A.3(a).

(b) For tracking, reporting and resolution of ETOPS significant occurrences refer to EASA AMC 20-6.

II. Draft Decision amending CS-Definitions:

Introduce new definitions as follows:

'ETOPS Configuration, Maintenance and Procedures (CMP) Standard' means the particular aeroplane or engine configuration minimum requirements, including any special inspection, hardware life limits, Master Minimum Equipment List (MMEL) constraints and maintenance practices found necessary by the Agency to establish the suitability of an airframe/engine combination for ETOPS.

'ETOPS (Extended Range Operations for Two-Engined Aeroplanes)' means those operations of two-engined aeroplanes that are approved by the Authority (ETOPS approval), to operate beyond the threshold distance determined in accordance with operational requirements from an "Adequate Aerodrome".

'Adequate Aerodrome' means an aerodrome which the operator considers to be satisfactory, taking account of the applicable performance requirements and runway characteristics; at the expected time of use, the aerodrome will be equipped with necessary ancillary services such as ATS, sufficient lighting, communications weather reporting, navaids and emergency services.

III. Draft Decision amending CS-25:

Introduce new paragraph CS 25.1535 to read as follows:

CS 25.1535 ETOPS approval

Each applicant seeking approval for ETOPS must:

(a) Comply with the requirements of CS-25 considering the maximum mission time and the longest diversion time for which approval is being sought.

(b) Consider crew workload and operational implications and the flight crew's and passengers' physiological needs of continued operations with failure effects for the longest diversion time for which approval is being sought.

(c) Establish appropriate limitations.

(See AMC 20-6)

IV. Draft Decision amending CS-E:

Amend paragraph CS-E.1040 to read as follows:

CS-E 1040 ETOPS

~~(Reserved)~~

Each applicant seeking engine approval for ETOPS capability must show that the engine will achieve an IFSD rate that is compatible with the safety target associated to the maximum mission time and the longest diversion time for which approval is being sought.

(See AMC 20-6)

V. Draft Decision amending AMC to Part M:

1. Amend AMC M.A.302(c) and add new paragraph 7 to read as follows:

AMC M.A.302(c) Maintenance programme compliance

…

7. In the case of aircraft operated in accordance with an ETOPS approval the Maintenance Programme should:

(a) contain the standards, guidance and direction necessary to support the intended operations. Specific ETOPS tasks identified by the (Supplemental) Type Certificate Holder in the Configuration, Maintenance and Procedures document (CMP) or equivalent, should be included in the programme and identified as ETOPS tasks as applicable;

(b) preclude identical errors being applied to multiple similar elements in any ETOPS maintenance significant system, for example staggering of identical tasks; and;

(c) include tasks to maintain the integrity of cargo compartment and pressurisation sealing features, including baggage hold liners, door seals and drain valve condition. Processes should be implemented to monitor the effectiveness of the maintenance programme in this regard.

2. Amend AMC M.A.302(d) and introduce a new paragraph 6 to read as follows:

AMC M.A.302(d) Maintenance programme-reliability programmes

…

6. "Specific tasks linked to specific operations" means those tasks required to be completed to assure the reliability and accuracy of the systems having an impact on operations requiring specific approval, such as ETOPS, RVSM, MNPS, RNP etc.

(a) For all aircraft used for ETOPS operations, engine oil consumption and condition monitoring programmes should be implemented.

(b) The oil consumption programme should reflect the manufacturer's recommendations and be sensitive to oil consumption trends. In the case of ETOPS operations, 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.

(c) If oil analysis is meaningful to the type of engine installed, it should be included in the programme.

(d) If the APU is required for ETOPS operation, it should be added to the oil consumption programme.

(e) The engine condition monitoring programme should ensure that engine limit margins are maintained so that a prolonged one-engine-inoperative diversion may be conducted without exceeding approved engine limits (e.g. 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 one-engine-inoperative flight phase associated with the diversion.

(f) The engine condition monitoring 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.

(g) In the case of aircraft operated in accordance with an ETOPS approval 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 event 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 this verification programme. Primary systems or conditions requiring verification actions should be described in the M.A Subpart G organisation's ETOPS procedures. The M.A Subpart G organisation may request the support of (Supplemental) Type Certificate holder to identify when these actions are necessary.

(h) Notwithstanding sub-paragraph g above, the M.A Subpart G organisation may propose alternative operational procedures to ensure system integrity. This may be based on system monitoring in the period of flight prior to entering an ETOPS area.

~~6~~7. Appendix 1 to AMC M.A.302 and M.B.301 (d) gives further guidance.

3. Amend AMC M.A.501 to read as follows:

AMC M.A.501 (b) – Installation

…

2 The fitment of a replacement components/material should only take place when the person referred to under M.A.801 or the M.A. Subpart F maintenance organisation is satisfied that such components/material meet required standards in respect of manufacture or maintenance or operational approval configuration (ETOPS, RVSM, etc.), as appropriate.

4. Amend AMC M.A.704 and add a new paragraph 7 to read as follows:

AMC M.A.704 Continuing airworthiness management exposition

…

6. In the case of aircraft operated in accordance with an ETOPS approval, the M.A. Subpart G organisation should develop appropriate procedures to be used by all personnel involved in, including supportive training programmes, duties, and responsibilities.

~~7~~8. The operator may use electronic data processing (EDP) for publication of the continuing airworthiness management exposition. The continuing airworthiness management exposition should be made available to the approving competent authority in a form acceptable to the competent authority. Attention should be paid to the compatibility of EDP publication systems with the necessary dissemination of the continuing airworthiness management exposition, both internally and externally.

~~8~~9. Part 0 "General organisation" of the continuing airworthiness management exposition should include a corporate commitment by the M.A Subpart G organisation, signed by the accountable manager confirming that the continuing airworthiness management exposition and any associated manuals define the organisation compliance with Part-M and will be complied with at all times.

~~9~~10. The accountable manager's exposition statement should embrace the intent of the following paragraph and in fact this statement may be used without amendment. Any modification to the statement should not alter the intent:

This exposition defines the organisation and procedures upon which the competent authority M.A. Subpart G continuing airworthiness management approval is based.

These procedures are approved by the undersigned and should be complied with, as applicable, in order to ensure that all continuing airworthiness tasks of..... (Quote operators's name)...... fleet of aircraft and/or of all aircraft under contract in accordance with M.A.201 (e) with..... (Quote organisation's name)...... are carried out on time to an approved standard.

It is accepted that these procedures do not override the necessity of complying with any new or amended regulation published from time to time where these new or amended regulations are in conflict with these procedures.

It is understood that the competent authority will approve this organisation whilst the competent authority * is satisfied that the procedures are being followed and the work standard maintained. It is understood that the competent authority reserves the right to suspend, vary or revoke the M.A. Subpart G continuing airworthiness management approval of the organisation or the air operators certificate, as applicable, if the competent authority has evidence that the procedures are not followed and the standards not upheld.

Signed ....

Dated ....

Accountable Manager and ...(quote position).......

For and on behalf of .....(quote organisation's name)...... "

Where it states competent authority please insert the actual name of the approving competent authority organisation or administration delivering the M.A. Subpart G continuing airworthiness management approval or the air operators certificate.

~~10~~11. Whenever the accountable manager is changed it is important to ensure that the new accountable manager signs the paragraph 9 statement at the earliest opportunity as part of the acceptance by the approving competent authority.

Failure to carry out this action invalidates the M.A. Subpart G continuing airworthiness management approval or the air operators certificate.

~~11~~12. The exposition should contain information as applicable, on how the continuing airworthiness management organisation complies with the CDDCCL instructions

Appendix V contains an example of an exposition lay-out.

5. Amend AMC M.A.706 and add a new paragraph to read as follows:

AMC M.A.706 Personnel requirements

…

4.9 in case of aircraft involved in ETOPS operations, knowledge of ETOPS concept and procedures.

6. Amend AMC M.B.301(b) and introduce and new paragraph 7 to read as follows:

AMC M.B.301 (b) Maintenance programme

…

7. In the case of aircraft operated in accordance with an ETOPS approval, the quality of maintenance and reliability programmes can have an appreciable effect on the reliability of the propulsion system and the ETOPS Maintenance Significant Systems. An assessment should be made of the proposed maintenance and reliability programme's ability to maintain a acceptable level of safety for the propulsion system and the ETOPS Maintenance Significant Systems of the particular airframe/engine combination. Type specific ETOPS requirements may be summarised in a single document, frequently referred to as Configuration, Maintenance and Procedures (CMP).

~~7~~8. The competent authority may approve an incomplete maintenance programme at the start of operation of an aircraft or an operator, subject to limiting the approval of the maintenance programme to a period that does not exceed any required maintenance not yet approved.

~~8~~9. If the competent authority is no longer satisfied that a safe operation can be maintained, the approval of a maintenance programme or part of it may be suspended or revoked. Events giving rise to such action include:

~~8~~9.1 An operator changing the utilisation of an aircraft;

~~8~~9.2 The owner or M.A. Subpart G approved organisation has failed to ensure that the programme reflects the maintenance needs of the aircraft such that safe operation can be assured.

7. Amend Appendix I to AMC. M.A.302 and AMC M.B.301(b) to read as follows:

Appendix I to AMC M.A.302 and AMC M.B.301 (b)

…

6. Reliability Programmes

6.1 Applicability

6.1.1 A reliability programme should be developed in the following cases:

(a) the aircraft maintenance programme is based upon MSG-3 logic

(b) the aircraft maintenance programme includes condition monitored components

(c) the aircraft maintenance programme does not contain overhaul time periods for all significant system components

(d) when specified by the Manufacturer's maintenance planning document or MRB.

(e) the aircraft operates in accordance with an ETOPS approval

….

6.2 Reliability programme

In preparing the programme details, account should be taken of this paragraph. All associated procedures should be clearly defined.

…

6.5.6.4 The ETOPS reliability 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. The Authority should be notified within 96 hours of events reportable through this programme.

In addition to the items generally required to be reported, the following items concerning ETOPS should be included;

(a) in-flight shutdowns;

(b) diversion or turn-back;

(c) un-commanded power changes or surges;

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

(e) problems with ETOPS Maintenance Significant Systems.

The report should identify the following:

(a) aircraft identification;

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

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

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

(e) phase of flight; and

(f) corrective action.

The M.A Subpart G organisation should ensure that the aircraft reliability programme includes assessment of ETOPS Maintenance Significant System performance during scheduled inspection/testing, to detect system failure trends in order to implement appropriate corrective action such as scheduled task adjustment.

An ETOPS Maintenance Significant System is (See also AMC 20-6):

(A) A system for which the redundancy characteristics are directly linked to the number of engines.

(A) A system that may affect the proper functioning of the engines to the extent that it could result in an in-flight shutdown or un-commanded loss of thrust.

(A) A system, which contributes significantly to the safety of a diversion.

6.5.6.45 Where the M.A Subpart G organisation relies upon contracted maintenance and/or overhaul facilities as an information input to the programme, the arrangements for availability and continuity of such information should be established and details should be included.

…

6.5.12 Reporting to the competent Authority

(a) The operator's assessment of propulsion systems reliability for the ETOPS/LROPS fleet should be made available to the competent 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 ETOPS operations.

(b) The assessment should include, as a minimum, engine hours flown in the period, in-flight shutdown rate for all causes and engine removal rate, both on a 12-months moving average basis. Where the combined ETOPS fleet is part of a larger fleet of the same aircraft/engine combination, data from the operator's total fleet will be acceptable.

(c) Any adverse sustained trend would require an immediate evaluation to be accomplished by the operator in consultation with the competent Authority. The evaluation may result in corrective action or operational restrictions being applied.

(d). A high engine in-flight shutdown rate for a small fleet may be due to the limited number of engine operating hours and may not be indicative for an unacceptable trend. The underlying causes for such an increase in the rate will have to be reviewed on a case-by-case basis in order to identify the root cause of events so that the appropriate corrective action is implemented.

(e). An Operator shall not be considered responsible for the occurrence of a design related event in its fleet. However, maintenance or operational problems may be wholly, or partially, the responsibility of the Operator. If an Operator has an unacceptable engine in-flight shutdown rate caused by maintenance or operational practices, then an appropriated corrective and/or enforcement action should be considered and when necessary taken.

6.5.13 APU in-flight start programme

(a) Where an APU is required for ETOPS and the aircraft is not operated with this APU running prior to the ETOPS entry point, the operator should initially implement a cold soak in-flight starting programme to verify that start reliability at cruise altitude is above 95%.
Once the APU in-flight start reliability is proven, the periodic APU in-flight start monitoring programme may be minimised or even discontinued. The APU in-flight start monitoring programme should be acceptable to the competent authority.

(b) The Maintenance procedures should include the verification of in-flight start reliability following maintenance of the APU and APU components, as defined by the OEM, where start reliability at altitude may have been affected.

8. Amend Appendix V to AMC M.A.704 to read as follows:

Appendix V to AMC M.A.704 Continuing airworthiness management organisation exposition

…

TABLE OF CONTENT

1.10	Reliability programmes.
1.11	Pre-flight inspections.
1.12	Aircraft weighing.
1.13	Check flight procedures.
1.14	ETOPS procedures
Part 2	**Quality system**
2.1	Continuing airworthiness quality policy, plan and audits procedure.
2.2	Monitoring of continuing airworthiness management activities.
2.3	Monitoring of the effectiveness of the maintenance programme(s).
2.4	Monitoring that all maintenance is carried out by an appropriate maintenance organisation.
2.5	Monitoring that all contracted maintenance is carried out in accordance with the contract, including sub-contractors used by the maintenance contractor.
2.6	Quality audit personnel.
Part 3	**Contracted Maintenance**
3.1	Maintenance contractor selection procedure.
3.2	Quality audit of aircraft.
Part 4	**Airworthiness review procedures**
4.1	Airworthiness review staff.
4.2	Review of aircraft records.
4.3	Physical survey.
4.4	Additional procedures for recommendations to competent authorities for the import of aircraft.
4.5	Recommendations to competent authorities for the issue of ARC.
4.6	Issuance of ARC.
4.7	Airworthiness review records, responsibilities, retention and access.
Part 5	**Appendices**
5.1	Sample documents.
5.2	List of airworthiness review staff.
5.3	List of sub-contractors as per AMC M.A.201 (h) 2 and M.A.711 (a) 3.
5.4	List of approved maintenance organisations contracted.
5.5	Copy of contracts for sub-contracted work (appendix 2 to AMC M.A.201 (h) 2).
5.6	Copy of contracts with approved maintenance organisations.

…

1.14 ETOPS procedures

(This paragraph should specify the procedures necessary to ensure the continuing airworthiness of the aircraft particularly related to ETOPS operations. It should address the following subjects as applicable).

a) General description of ETOPS processes

b) Engine oil consumption monitoring

c) APU oil consumption monitoring

d) Engine/APU Oil analysis

e) Engine conditioning monitoring

f) Verification programme after maintenance

g) Defect reporting

h) Propulsion System Monitoring/Reporting

i) Maintenance training

j) Parts and configuration control

k) APU in-flight start programme

l) ETOPS maintenance significant system reliability

9. Amend Appendix XI to AMC to M.A.708(c) to read as follows:

Appendix XI to AMC to M.A.708(c)

CONTRACTED MAINTENANCE

1. Maintenance contracts

The following paragraphs are not intended to provide a standard maintenance contract but to provide a list of the main points that should be addressed, when applicable, in a maintenance contract between an Operator and a Part-145 approved organisation. As only the technical parts of the maintenance contracts have to be acceptable to the competent authority, the following paragraphs only address technical matters and exclude matters such as costs, delay, warranty, etc...
When maintenance is contracted to more than one Part-145 approved organisation (for example aircraft base maintenance to X, engine maintenance to Y and line maintenance to Z1, Z2&Z3), attention should be paid to the consistency of the different maintenance contracts.

A maintenance contract is not normally intended to provide appropriate detailed work instruction to the personnel (and is not normally distributed as such). Accordingly there must be established organisational responsibility, procedures and routines in the Operator's M.A.Subpart G & Part-145 organisations to take care of these functions in a satisfactory way such that any person involved is informed about his responsibility and the procedures which apply. These procedures and routines can be included/appended to the operator's CAME and maintenance organisation's MOE or consist in separate procedures. In other words procedures and routines should reflect the conditions of the contract.

In order to ensure that the interface between an ETOPS operator and contracted Part-145 Maintenance Organisations is sufficiently robust and that ETOPS processes gain a high emphasis, it is necessary to include specific reference to this ETOPS related AMC material within the contract.

2. Aircraft maintenance

This paragraph applies to a maintenance contract that includes base maintenance and, possibly, line maintenance. Paragraph 4 of this appendix addresses the issue of maintenance contracts restricted to only line maintenance. Aircraft maintenance also includes the maintenance of the engines and APU while they are installed on the aircraft.

…

2.23. ETOPS Procedures

The contract should specify procedures related to ETOPS involving the Part-145 organisation. These may include but are not limited to:

- Engine/APU oil consumption monitoring
- Engine condition monitoring
- APU component replacement, in-flight start programme
- Parts configuration control
- Engineer training/authorisation standards
- ETOPS task identification
- Verification programme after maintenance

…

3. Engine maintenance

This paragraph deals with engine shop maintenance. "On wing" engine maintenance should be covered by paragraph 2 above.

…

3.22. ETOPS Procedures

The contract should specify procedures related to ETOPS involving the Part-145 organisation. These may include but are not limited to:

- Engine/APU oil consumption monitoring
- Engine condition monitoring
- Parts configuration control
- Engineer training/authorisation standards
- ETOPS task identification

…

4. Aircraft line maintenance

This paragraph applies to maintenance contract that includes line maintenance but excludes base maintenance activities.

…

~~9~~4.7. Pooled parts.
The contract should specify how the subject of pooled parts at line stations should be addressed.

~~9~~4.8. Unscheduled maintenance/Defect rectification.
The contract should specify to which level the Part-145 approved organisation may rectify a defect without reference to the operator, and what action should be taken in case the defect rectification may not be performed by the Part-145 approved organisation.

~~9~~4.9. Deferred tasks.
The use of the operator's MEL and the relation with the operator in case of a defect that cannot be rectified at the line station should be addressed.

~~9~~4.10. Release to service.
The release to service has to be performed by the Part-145 approved organisation in accordance with its MOE procedures. The contract should however specify which support forms have to be used (operator's technical log, etc...).

~~9~~4.11. Exchange of information.
Each time exchange of information between the operator and Part-145 approved organisation is necessary, the contract should specify what information should be provided and when, how, by whom and to whom it has to be transmitted.

~~9~~4.12. Meetings.
Before the contract is applicable, it may be beneficial that the technical personnel of both parties that are involved in the application of the contract meet in order to be sure that every point leads to a common understanding of both parties' duties.

4.13. ETOPS Procedures

The contract should specify procedures related to ETOPS involving the Part-145 organisation. These may include but are not limited to:

- Engine/APU oil consumption monitoring
- Engine condition monitoring
- APU component replacement, in-flight start programme
- Parts configuration control
- Engineer training/authorisation standards
- ETOPS task identification
- Verification programme after maintenance

VI. Draft Decision amending AMC to Part-145:

Amend AMC 145.A30(e) and introduce a new paragraph to read as follows:

AMC 145.A.30(e) Personnel requirements

…

6. Maintenance personnel that are involved in ETOPS maintenance tasks should complete an ETOPS training programme and should have satisfactorily performed ETOPS tasks under supervision, within the framework of the Part-145 approved procedures for Personnel Authorisation.

~~6~~ 7. In respect to the understanding of the application of human factors and human performance issues, maintenance, management, and quality audit personnel should be assessed for the need to receive Initial human factors training, but in any case all maintenance, management, and quality audit personnel should receive human factors continuation training. This should concern to a minimum:

– Post-holders, managers, supervisors;
– Certifying staff, technicians, and mechanics;
– Technical support personnel such as, planners, engineers, technical record staff;
– Quality control/assurance staff;
– Specialised services staff;
– Human factors staff/ human factors trainers;
– Store department staff, purchasing department staff;
– Ground equipment operators;
– Contract staff in the above categories.

~~7~~8. Initial human factors training should cover all the topics of the training syllabus specified in GM 145.A.30(e) either as a dedicated course or else integrated within other training. The syllabus may be adjusted to reflect the particular nature of the organisation. The syllabus may also be adjusted to meet the particular nature of work for each function within the organisation. For example:

– small organisations not working in shifts may cover in less depth subjects related to teamwork and communication,

– planners may cover in more depth the scheduling and planning objective of the syllabus and in less depth the objective of developing skills for shift working.

Depending on the result of the evaluation as specified in paragraph 5, initial training should be provided to personnel within 6 months of joining the maintenance organisation, but temporary staff may need be trained shortly after joining the organisation to cope with the duration of employment.

Personnel being recruited from another maintenance organisation approved under Part-145 and temporary staff should be assessed for the need to receive any additional Human factors training to meet the new maintenance organisation's approved under Part-145 human factors training standard.

~~8~~9. The purpose of human factors continuation training is primarily to ensure that staff remains current in terms of human factors and also to collect feedback on human factors issues. Consideration should be given to the possibility that such training has the involvement of the quality department. There should be a procedure to ensure that feedback is formally passed from the trainers to the quality department to initiate action where necessary.

Human factors continuation training should be of an appropriate duration in each two year period in relation to relevant quality audit findings and other internal/external sources of information available to the organisation on human errors in maintenance.

~~9~~10. Human factors training may be conducted by the maintenance organisation itself, or independent trainers or any training organisations acceptable to the competent authority.

~~10~~11. The Human factors training procedures should be specified in the maintenance organisation exposition.

VII. Draft Decision amending AMC-20:

Amend AMC 20-6 to read as follows:

AMC 20-6
Extended Range Operation with Two-Engined Aeroplanes ETOPS Certification and Operation

1 PURPOSE

This AMC states an acceptable means but not the only means for obtaining approval for two-engined aeroplanes to operate 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. This AMC 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, 180 minutes, etc.). Operational requirements may also be related to diversion time.

The content of the AMC will be related to diversion time as follows:

a. by having three sets of design criteria: 75 minutes or less, more than 75 but less than 90 minutes and 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.~~b. by having ~~three~~ four 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 and above 180 minutes.

Accelerated ETOPS:

(i) 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 AMC. 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).

(ii) Type Design Approval (TDA)

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

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

(C) Operators and ~~Manufacturers~~ (S)TC holders 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.

2 RELATED REFERENCES

CS-Definitions,

Part 21,

Part 145,

Part M,

CS 25.901, 25.903, 25.1309, 25.1351 (d), 25.1419, 25.1535, CS-25 Subpart J, CS-E 510, CS-E 515, CS-E 520, operational requirements.

3 RESERVED

4 TERMINOLOGY

a. *Aerodrome*

(1) Adequate. For the purpose of this AMC, 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 AMC 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 or engine configuration minimum requirements, including any special inspection, hardware life limits, Master Minimum Equipment List (MMEL) constraints and maintenance practices found necessary by the ~~Authority~~ Agency 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~~ as defined in the Engine (Supplemental) Type Certificate and Engine Type Certificate Data Sheet.

e. *Extended Range Operations*

For the purpose of this AMC, 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~~.

g. *Despatch*

ETOPS planning minima applies until dispatch. Despatch is when the aircraft first moves under its own power for the purpose of taking off.

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 (Type Design Approval)*

~~(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.~~

ETOPS Significant System means the aeroplane propulsion system and any other aeroplane system whose failure could adversely affect the safety of an ETOPS flight, or whose functioning is important to continued safe flight and landing during an aeroplane diversion. Each ETOPS significant system is either a Group 1 or Group 2 system based on the relationship to the number of engines, or to continued safe engine operation.

(1) ETOPS Group 1 Systems:

Group 1 Systems are ETOPS significant systems that, related to the number of engines on the aeroplane or the consequences of an engine failure, make the systems' capability important for an ETOPS flight. The following provides additional discriminating definitions of an ETOPS Group 1 Significant System:

(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 in-flight 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 an engine inoperative ETOPS diversion and is intended to provide additional redundancy to accommodate the system(s) lost by the inoperative engine. These include back-up systems such as an emergency generator, APU, etc.

(iv) A system essential for prolonged operation at engine inoperative altitudes such as anti-icing systems for a two-engined aeroplane if single engine performance results in the aeroplane operating in the icing envelope.

(2) ETOPS Group 2 Systems:

Group 2 Systems are ETOPS significant systems that do not relate to the number of engines on the aeroplane, but are important to the safe operation of the aeroplane on an ETOPS flight. The following provides additional discriminating definitions of an ETOPS Group 2 Significant System:

(i) A system for which certain failure conditions “would reduce the capability of the aeroplane or the ability of the crew to cope with” an ETOPS diversion (e.g., long range navigation or communication, equipment cooling, or systems important to safe operation on a ETOPS diversion after a decompression such as anti-icing systems).

(ii) Time-limited systems including such things as cargo fire suppression and oxygen if the ETOPS diversion is oxygen system duration dependent.

(iii) Systems whose failure would result in excessive crew workload or have operational implications or significant detrimental impact on the flight crew’s or passengers’ physiological well being for an ETOPS diversion (e.g., flight control forces that would be exhausting for a maximum ETOPS diversion, or system failures that would require continuous fuel balancing to ensure proper CG, or a cabin environmental control failure that could cause extreme heat or cold to the extent it could incapacitate the crew or cause physical harm to the passengers).

(iv) A system specifically installed to enhance the safety of ETOPS operations and an ETOPS diversion regardless of the applicability of paragraphs (2)(i), (2)(ii) and (2)(iii) above (e.g., SATCOM, GPS).

j. *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.

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

(2) Propulsion System. The aeroplane propulsion system includes: the engine and 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.~~k. *Approved One-Engine-Inoperative Cruise Speed*

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

(2) The operator must 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 paragraph 10.d.(4) Fuel and Oil Supply of this AMC 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 the operational requirements.

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

l. *Early ETOPS*

Obtaining ETOPS type design approval without first gaining in-service experience on the airframe/engine combination.

m. *Maximum Approved Diversion Time*

A maximum approved diversion time for the airframe/engine combination or the engine, established in accordance with the type design criteria in this AMC and Appendices 1 and 2 of this AMC. This Maximum Approved Diversion Time is reflected in the aeroplane and engine Type Certificate Data Sheets. The Maximum Approved Diversion Times for the aeroplane should not be exceeded and are reflected in the AFM or AFM-supplement.

Any proposed increase in the Maximum Approved Diversion Time, or changes to the aircraft or engine, should be re-assessed by the (S)TC holder in accordance with Part 21A.101, to establish if any of the Type Design criteria in this AMC should be applied.

n. *Operator's Approved Diversion Time*

"Operator's Approved Diversion Time" is the maximum time authorised by the Authority that the operation can operate a type of aeroplane at the approved one-engine-inoperative cruise speed (under standard conditions in still air) from an ETOPS Adequate Aerodrome for the area of operation.

o. *Accelerated ETOPS*

A process based method for obtaining an ETOPS Approval by an operator, not solely based on in-service experience, up to 180 minutes Operators Approved Diversion Time.

5 GENERAL ELIGIBILITY CONSIDERATIONS

To be eligible for extended range operations, the specified airframe/engine combination should have been certificated to the airworthiness standards of Large Aeroplanes and should be evaluated considering the concepts in paragraph 7, evaluated considering the type design considerations in paragraph 8 and Appendix 1 and 2, evaluated considering in-service experience for ETOPS type design discussed in paragraph 9 or Approval Plan (CRI) for ~~Accelerated~~ "Early" ETOPS Type Design Approval and evaluated considering the continuing airworthiness and operational concepts outlined in Part M and in paragraph 10 of this AMC.

6 APPLICABILITY AND GRANDFATHER CLAUSES

Applicability and grandfather clauses will be found, when appropriate, in the operational requirements.

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-engined 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-engined aeroplanes. This approach ensures that two-engined 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.

a. *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.

b. *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-engined 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).

c. *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.

d. *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.

e. *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 is not required.

f. *Approval Basis*

Each applicant (~~manufacturer~~ (S)TC holder 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~~ (S)TC holder 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 Agency approved ~~Aeroplane~~ Aircraft Flight Manual (AFM) or AFM-Supplement 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).

(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 or AFM-Supplement.

(4) *Continuing Airworthiness*

The type design ETOPS Approval holder and the Agency 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 Agency 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 Agency.

Note: See also Appendix 1 paragraph 6 '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-engined 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~~ should be determined that it can achieve a level of reliability suitable for the intended operation.

a. Eligibility

As discussed in paragraph 5 above, to be eligible for extended range operations (ETOPS), the specified airframe/engine combination and engine, should have been certificated according to the airworthiness standards of commercial air transport of large aeroplanes and Engines. They should be evaluated considering the concepts and the type design considerations in this AMC, and Appendices 1 and 2. The required reliability of the airframe/engine combination, and of the engine, can be validated by:

(1) in-service experience for ETOPS Type Design Approval defined in paragraph 9 and Appendices 1 and 2 of this AMC, or

(2) an agreed Approval Plan for Early ETOPS Type Design Approval defined in Appendices 1 and 2 of this AMC, or

(3) for the aeroplane, a combination of (1) and (2).

b. Early ETOPS

(1) ETOPS Approval is considered feasible at the introduction to service of an airframe/engine combination, as long as the Agency is totally satisfied that all aspects of an agreed Approval Plan have been completed. The Agency must be satisfied that the approval plan achieves the level of safety intended in this AMC and the aeroplane and engine certification bases.

(2) Any deficiency in compliance with the Approval Plan can result in a lesser approval than sought for.

(3) (S)TC holders 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 type design approval. Any isolated problem not justifying immediate withdrawal of approval, should be addressed in a (by the Agency approved) resolution plan within 30 days. (S)TC holders will be reliant on operators to supply incident and occurrence data.

~~a.~~ c. *Request for Approval*

An applicant for, and holders of a (S)TC ~~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 Agency. The Agency will then initiate an assessment of the engine and airframe/engine combination in accordance with paragraphs 8, 9 and Appendix 1 & 2 of this AMC.

~~b.~~ *d. 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. Excluding failures of the engine, any system or equipment failure condition that affects the aeroplane or engine, or combination of failures that would result in a need for a diversion, should be considered a Major event (CS 25.1309) and therefore the probability of such should be compatible with that safety objective. 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 AMC to Part M).

Note: Adequate, as referred to in first line of 8.~~b~~d.(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~~ Agency 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. The APU should demonstrate the required in-flight start reliability throughout the flight envelope (compatible with overall safety objective but not less than 95%**),** or an acceptable procedure demonstrated for starting and running the APU, (e.g. descent to allow start), taking account of all approved fuel types and temperatures. If this reliability cannot be demonstrated, it may be necessary to require continuous operation of the APU.

(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).~~

Consideration should also be given to the effects on the flight crew's and passengers' physiological needs (e.g., cabin temperature control), when continuing the flight with an or more engine and/or airframe system inoperative.

The provision of essential services to ensure the continued safety of the aeroplane and safety of the passengers and crew, particularly during very long diversion times with depleted systems, should be assessed. The assessments of ETOPS significant systems should be carried out to give particular attention to ensure, for example:

(i) Flight deck and cabin environmental systems integrity and reliability

(ii) The avionics/cooling and consequent integrity of the avionic systems

(iii) Cargo hold fire suppression capacity and integrity of any smoke/fire alerting system

(iv) Brake accumulator or emergency braking system capacity/integrity

(v) Adequate capacity of all time dependent functions

(vi) Pressurisation System integrity/reliability

(vii) Oxygen System integrity/reliability/capacity, if the Maximum Approved Diversion Time is based on the oxygen system capability

(viii) Integrity/reliability/capacity of back-up systems (e.g. electrical, hydraulic)

(ix) Fuel system integrity and fuel accessibility. Fuel consumption with engine failure and/or other system failures (see paragraph 8 d.(11))

(x) Fuel quantity and fuel used, indications and alerts (see paragraph 8 d.(10)).

(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/~~Agency. These should normally include:

(i) attitude information;

(ii) adequate radio communication (including the route specific long range communication equipment as required by the applicable operational regulations) and intercommunication capability;

(iii) adequate navigation capability (including route specific long range navigation equipment as required by the applicable operational regulations and 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~~d.(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~~d. (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~~d. (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) For ETOPS approvals above 180 minutes, and in order to meet the safety objective (i.e. Extremely Improbable) associated with the total loss of electrical power, including in combination with an engine failure, in addition to the criteria for electrical power sources specified in paragraph 8d.(8) above, the following criteria should also be applied:

(i) Any one of the three independent electrical power sources should be capable of, and available to supply power to all technical loads/functions/systems (typically all main, essential, standby and emergency bus bars, but excluding galleys, IFE systems etc).

(ii) To meet CS 25.1351(d), following the failure of any power source combined with the loss or failure of the other two sources, further power source(s) should be available that is (are) capable of providing power to the essential functions for continuous safe flight and landing.

(iii) Where one of the above power sources is an APU, it should meet the criteria in paragraph 8 d.(4).

(iv) If the additional power source is provided by a hydraulic system or ram air turbine the provisions of paragraph 8 d.(8) apply.

(v) The list of essential functions to be powered from the standby power source for continuous safe flight and landing, is as defined in paragraph 8 d.(7).

~~(9)~~(10) 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.

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

~~(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) Fuel system

(i) The aeroplane fuel system should provide fuel pressure and flow to the engine(s) in accordance with CS 25.951 and 25.955 for any fuel pump power supply failure condition not shown to be Extremely Improbable.

(ii) The fuel necessary to complete the ETOPS mission or during a diversion should be available to the operating engine(s) under any failure condition, other then fuel boost pump failures, not shown to be Extremely Improbable. (e.g. crossfeed valve failures, automatic fuel management system failures)

(12) Time-limited system

In addition to the Maximum Approved Diversion Time, diversion time may also be limited by the capacity of the cargo hold fire suppression system or other time-limited systems determined by considering other relevant failures, such as an engine inoperative, and combinations of failures not shown to be Extremely Improbable.

Time-limited system capability, if any, must be defined and stated in the Aeroplane Flight Manual or AFM-supplement.

~~(11)~~(13) Operation in icing conditions

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.

(i) The aeroplane should be certificated for operation in icing conditions in accordance with CS 25.1419.

(ii) The aeroplane should be capable of continued safe flight at engine inoperative and depressurisation altitudes, and landing in icing conditions.

The extent of ice accumulation on unprotected surfaces should consider the maximum super cooled liquid water catch at one-engine inoperative and depressurisation cruise altitudes. Substantiated icing scenario(s) should be assumed to occur during the period of time when icing conditions are forecast. The icing episode(s) assumed should be agreed with the Agency. The probability of icing longer than that assumed, and agreed for the icing episode(s), in combination with the probability of the aeroplane having to operate in icing conditions (e.g. engine in-flight shut down or decompression) should be shown to be Extremely Improbable.

~~(12)~~(14) 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.

(15) Engine Condition Monitoring.

Procedures for an engine condition monitoring process should be defined and validated for ETOPS. The engine condition monitoring process should be able to determine, pre-flight, if an engine is no longer capable of providing, within certified engine operating limits, the maximum thrust required for a single engine diversion. The effects of additional engine loading demands (e.g., anti-ice, electrical), which may be required during an engine inoperative diversion, must be accounted for.

~~c.~~ *e. 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~~d. 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) *Airframe systems*

An assessment of the airframe system's reliability for particular airframe/engine combinations should be made in accordance with paragraph 8.d and Appendix 2.

The analysis should consider:

~~(3)~~(i) Hydraulic Power and Flight Control

An analysis should be carried out taking into account the criteria detailed in paragraph 8.~~b.~~d.(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~~d 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)~~(ii)Services Provided by Electrical Power

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

Note1: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.~~b~~d. 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.

Note 2: For ETOPS approval above 180 minutes, the analysis should also show that the criteria detailed in paragraph 8.d.(9) are satisfied.

~~(5)~~(iii) 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~~d. 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)~~(iv) Cargo Compartment

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

~~(i)~~(A) 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)~~(B) 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. The capacity/endurance of the cargo compartment fire suppression system will be a factor in the determination of the Maximum Approved Diversion Time. This capacity/endurance can be based on the all-engines operating cruise speed in still air.

~~(7) Reserved~~

~~(8)~~(v) 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/Agency 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.~~d. (6)).

~~(9)~~(vi) 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 e.g. when the aeroplane is operating on standby electrical power only.

Note: For 75 minutes or less ETOPS approval, additional analysis to show compliance with paragraph 8.~~b~~d. 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.~~ f. 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 (S)TC holders and witnessed by the Agency 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 Agency 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)~~.

(4) Safety assessments should consider the flight consequences of single or multiple system failures leading to a diversion, and the probability and consequences of subsequent failures or exhaustion of the capacity of time-limited systems that might occur during the diversion.

Safety assessments should determine whether a diversion should be conducted to the nearest airport or to an airport presenting better operating conditions, considering:

(i) The effect of the initial failure condition on the capability of the aeroplane to cope with adverse conditions at the diversion airport, and
(ii) The means available to the crew to assess the extent and evolution of the situation during a prolonged diversion.

The aeroplane flight manual and the flight crew warning and alerting and display systems should provide clear information to enable the flight crew to determine when failure conditions are such that a diversion is necessary.

~~e.~~ g. ~~Authority~~ Agency 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~~ the Agency- approved Aeroplane Assessment Report. This report will be approved by the ~~Certification Authority~~ Agency after review and concurrence by the Authority responsible for Operations. In the case of a subsequent Certification Authority/Agency, the report may incorporate partly or totally the report established by the original Authority/Agency.

Following approval of the report, the propulsion and airframe system recommendations will be included in an ~~Authority~~ Agency-approved document that establishes the CMP standard requirements for the candidate ~~aeroplane~~ engine or airframe/engine combination. This document will then be referenced in the Operation Specification and the Aircraft Flight Manual or AFM-Supplement.

~~f.~~ h. 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 Agency and sufficient in-service experience data, (see Appendix 1 & 2):

(1) The type design approval, the Maximum Approved Diversion Time and demonstrated capability of any time-limited systems will be reflected in the approved AFM or AFM-Supplement, and the aeroplane and engine 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.~~ e.(1) and time-limited systems (for example, the endurance of cargo hold fire suppression systems);

(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 in accordance with CS-25, CS-E and AMC 20-6 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".

(2) The Engine ETOPS Type Design approval and Maximum Approved Diversion Time will be reflected in the engine Type Certification Data Sheet or Supplemental Type Certificate which contain directly or by referencing the following pertinent information, as applicable:

(i) special limitations (if necessary), including any limitations associated with the Maximum Approved Diversion Time should be established;

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

(iii) description or reference to a document containing the approved engine configuration.

~~g.~~ *i. Type Design Change Process*

(1) The Agency will include the consideration of extended range operation in its normal ~~monitoring~~ surveillance and design change approval functions.

(2) The (S)TC holders who's approval include a type design ETOPS approval, as well as the Agency should periodically and individually review the in-service reliability of the airframe/engine combination and the engine. Further to these reviews and every time that an urgent problem makes it necessary, the Agency may require that the type design standard be revised, for example by the issuance of an Airworthiness Directive, to achieve and maintain the desired level of reliability and therefore the safety of ETOPS.

~~(2)~~(3) The Reliability Tracking Board /Propulsion System Reliability Assessment Board (PSRAB) will periodically check that the airframe/propulsion system reliability requirements for extended range operation (see Appendix 1 and 2) are achieved or maintained.

Note: Periodically means in this context two years.

~~(3)~~(4) 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 Agency/Authority will co-ordinate this action with the affected manufacturer and operator.

~~(4)~~(5) The Airworthiness Directive process may be utilised as necessary to implement a CMP standard change.

~~h.~~ *j. Continued Airworthiness*

The ~~type design~~ CMP standard which establishes the suitability of an ~~aeroplane~~ engine or airframe/engine combination for extended range operation defines the minimum standard for the operation.

Additional modifications or maintenance actions generated by an operator or ~~manufacturer~~ (S)TC holder to enhance or maintain the continued airworthiness of the aeroplane or engine must be made through the normal approval process.

The operator or ~~manufacturer~~ (S)TC holder (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 FOR ETOPS TYPE DESIGN APPROVAL

In establishing the suitability of a type design in accordance with paragraph 8 of this AMC and as a pre-requisite to obtaining any operational approval in accordance with the criteria of paragraph 10 of this AMC, 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 Agency (see Appendix 1 and 2), 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.~~d.(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 10j 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. Applicability

This acceptable means of compliance is for ETOPS operations approvals to operate:

(1) Two-Engined aeroplanes with a maximum approved passenger seating configuration of 20 or more, or with a maximum take-off mass of 45360 kg or more, in excess of 60 minutes at the approved one-engine-inoperative speed (under standard conditions in still air) from an adequate aerodrome;

(2) or Two-Engined aeroplanes with a passenger seating configuration of 19 or less and a take-off mass of less than 45360 kg, in excess of 180 minutes at the approved one-engine-inoperative speed (under standard conditions in still air) from an Adequate Aerodrome

b. Applicable operational requirements

This section details the approval process required for ETOPS in accordance with the operational requirements. When the ETOPS approval is granted it will be recorded in the operations specification under special authorisations /approvals.

c. ETOPS Approval

There are two methods for obtaining an ETOPS approval, depending on the availability and amount of prior experience with the candidate airframe/engine combination:

- "Accelerated ETOPS approval", does not require prior in-service experience with the candidate airframe/engine combination;
- "In-service ETOPS Approval", based on a pre-requisite amount of prior in-service experience with the candidate airframe/engine combination. Elements from "Accelerated ETOPS approval" method may be used to reduce pre-requisite amount of prior in-service experience.

(1) Accelerated ETOPS Approval

It is a process based method for obtaining ETOPS approval up to 180 minutes diversion time.

(i) Requesting Approval

The criteria defined permit approval of ETOPS operations up to 180 minutes, when the operator has established that those processes necessary for successful ETOPS are in place and are proven to be reliable. The basis of accelerated approval is that the operator will meet equivalent levels of safety and satisfy the objectives of this AMC.

The operator should submit an Accelerated ETOPS Operations Approval Plan to the Authority six (6) months before the proposed start of ETOPS. This additional time will permit the Authority to review the documented plans and assure adequate ETOPS processes are in place.

(A) The operator's application for Accelerated ETOPS should:

1. Define proposed routes and the ETOPS diversion time necessary to support those routes;
2. The proposed one-engine-inoperative cruise speed which may be area specific depending upon anticipated aeroplane loading and likely fuel penalties associated with the planned procedures;
3. Define processes and related resources being allocated to initiate and sustain ETOPS operations in a manner that demonstrates commitment by management and all personnel involved in ETOPS continuing airworthiness and operational support;

4. 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;

5. Document plan for compliance with ETOPS Processes, listed in the next paragraph (Operators ETOPS Processes);

6. Define Review Gates. A Review Gate is a milestone-tracking plan to allow for the orderly tracking and documentation of specific requirements. 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 ETOPS and should continue at least six (6) months after the start of ETOPS. Assure that the proven processes comply with the provisions of this AMC and the associated appendices.

(B) Operators ETOPS Processes:

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 on-going basis. The ETOPS process elements that should be in place to ensure a successful Accelerated ETOPS programme are detailed in the next paragraph. A process is considered ‘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;
4. Indications of process stability/reliability;
5. Parameters to validate process and monitor (measure) success;
6. Duration of necessary evaluation to validate process;
7. Procedure for follow-up in-service monitoring to assure that the process remains reliable and controlled.

(C) The operator seeking Accelerated ETOPS Operations Approval should also demonstrate to the Authority that it has an ETOPS programme in place that addresses The following are the ETOPS process elements:

1. Airframe/engine combination and engine compliance to ETOPS Type Design Build Standard (CMP);

2. Compliance with the continuing airworthiness requirements as defined in Part M;

3. Fully developed Maintenance Programmes, which include a tracking and a proven ETOPS Reliability Programme, as indicated in Part M;
4. ETOPS manual in place;
5. A proven Oil Consumption Monitoring Programme;
6. A proven Engine Condition Monitoring and Reporting system as indicated in this AMC;
7. A proven Plan for Resolution of Aeroplane Discrepancies;
8. Propulsion system monitoring programme in Part M in place;
9. 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;
10. Initial and recurrent training and qualification programmes in place for ETOPS related personnel;
11. Established ETOPS parts control programme;
12. Compliance with the Flight Operations Programme as defined in this AMC;
13. Proven flight planning and dispatch programmes appropriate to ETOPS;
14. Availability of meteorological information and MEL appropriate to ETOPS;
15. Initial and recurrent training and checking programme in place for ETOPS flight operations personnel; and
16. Flight crew and dispatch personnel familiar with the ETOPS routes to be flown; in particular the requirements for, and selection of ETOPS en-route alternate aerodromes.

(D) Documentation should be provided for the following elements:

1. Technology new to the operator and significant differences in primary and secondary power systems (engines, electrical, hydraulic and pneumatic), compared to the aeroplanes currently operated and the aeroplane for which the operator is seeking Accelerated ETOPS Operations Approval;
2. The plan to train the flight and continuing airworthiness personnel to the different ETOPS process elements;

3. The plan to use proven or manufacturer validated Training and Maintenance and Operations Manual procedures relevant to ETOPS for the aeroplane for which the operator is seeking Accelerated ETOPS Operations Approval;
4. 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;
5. The validation plan for any additional operator unique training and procedures relevant to ETOPS, if any;
6. Details of any ETOPS programme support from the airframe/engine combination or engine (S)TC holder, other operators or any other outside authority; and
7. The control procedures when an outside party as described above provides maintenance or flight dispatch support.

(ii) Validation of the Operators ETOPS Processes

This section identifies process elements that need to be validated and approved prior to the start of Accelerated ETOPS. For a process to be considered proven, the process should first be defined, typically including a flow chart of process elements. The roles and responsibilities of the personnel managing the process should be defined including any training requirement. The operator should demonstrate that the process is in place and functions as intended. This can be accomplished by presenting data, documentation and analysis' results and/or by demonstrating in practise that the process works and consistently provides the intended results. The operator should also show that a feedback loop exists to facilitate the surveillance of the process, based on in-service experience.

With sufficient preparation and resources a validation may not be necessary to assure acceptable results. The Authority could require a validation where it considers the results are unacceptable. If any operator is currently approved for conducting ETOPS with a different engine and/or airframe/engine combination it may be able to document proven ETOPS processes. In this case only minimal further validation may be necessary. It will be necessary to demonstrate that processes are in place to assure equivalent results on the engine and/or airframe/engine combination being proposed for Accelerated ETOPS Operations Approval.

The following elements will be useful or beneficial in justifying a reduction in the requirements of ETOPS processes:

(A) Experience with other airframes and/or engines;

(B) Previous ETOPS experience;

(C) Experience with long range, over-water operations with two, three or four engine aeroplanes;

(D) Any experience gained by flight crews, continuing airworthiness personnel and flight dispatch personnel, while working with other ETOPS approved operators, particularly when such experience is with the same airframe or airframe/engine combination.

Process validation may be done on the airframe/engine combination, which will be used in Accelerated ETOPS operation or on a different aeroplane type than that for which approval is being sought.

A process could be validated by demonstrating that it produces equivalent results on a different aeroplane type or airframe/engine combination. In this case, the validation programme should address the following:

(A) The operator should show that it has considered the impact of the ETOPS validation programme with regard to safety of flight operations;

(B) 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;

(C) The validation scenario should be of sufficient frequency and operational exposure to validate maintenance and operational support systems not validated by other means;

(D) A means should be established to monitor and report performance with respect to accomplishment of tasks associated with ETOPS process elements. Any recommended changes to ETOPS continuing airworthiness and/or operational process elements should be defined.

The operator should:

(A) Document how each element of the ETOPS process was utilised during the validation;

(B) Document any shortcomings with the process elements and measures in place to correct such shortcomings;

(C) 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;

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

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

(A) Validation periods, including start dates and proposed completion dates;

(B) 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);

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

(D) Definition of designated ETOPS validation routes. The routes should be of duration required to ensure necessary process validation occurs;

(E) Process validation reporting. The operator should compile results of ETOPS process validation.

(iii) Validation of Operator ETOPS Continued Airworthiness and Operations Capability

The operator should demonstrate competence to safely conduct and adequately support the intended operation. Prior to ETOPS approval, the operator should demonstrate that the ETOPS continuing airworthiness processes are being properly conducted at their usual departure and destination aerodromes.

The operator should also demonstrate that ETOPS flight dispatch and release practices, policies, and procedures are established for operations to and from their usual departure and destination aerodromes.

An operational validation flight can be required so that the operator can demonstrate dispatch and normal in-flight procedures. The content of this validation flight will be determined by the Authority based on the previous experience of the operator.

Upon successful completion of a validation flight, where required, the operational specifications and manuals should be modified accordingly to include approval for ETOPS as applicable.

(iv) ETOPS Operations Approval issued by the Authority

Operations approvals granted with reduced in-service experience may be limited to those areas agreed by the Authority at time of issue. Additional approval is required for new areas to be added.
Operators may be eligible for ETOPS Operator’s Approved Diversion Time up to 180 minutes provided that the operator complies with all the requirements of the ETOPS Process Elements.

The approval issued by the Authority for ETOPS up to 180 minutes should specifically include provisions covering at least the following:

(A) Definition of the particular airframe/engine combinations, including the current approved CMP document required for ETOPS as normally identified in the AFM (See CS 25.1535);

(B) Authorised area of operation;

(C) Minimum altitudes to be flown along planned and diversionary routes;

(D) Operator's Approved Diversion Time;

(E) Aerodromes nominated for use, including alternates, and associated instrument approaches and operating minima;

(F) The approved maintenance and reliability programmes for ETOPS;

(G) Identification of those aeroplanes designated for ETOPS by make and model as well as serial number and registration;

(H) Define proposed routes and the ETOPS diversion time necessary to support those routes;

(I) The proposed one-engine-inoperative cruise speed which may be area specific depending upon anticipated aeroplane loading and likely fuel penalties associated with the planned procedures;

(J) Define processes and related resources being allocated to initiate and sustain ETOPS operations in a manner that demonstrates commitment by management and all personnel involved in ETOPS continued airworthiness and operational support.

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

~~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~~2) In-service ~~Experience for Operational~~ ETOPS Approval

Approval based on in-service experience on the particular airframe/engine combination.

(i) Requesting approval

Any operator requesting approval for ETOPS should submit a request, with the required supporting data, to the Authority at least 3 months prior to the proposed start of ETOPS with the specific airframe/engine combination.

(ii) Operator Experience

Each operator requesting Approval will be required to have appropriate experience. A summary must be provided to seeking approval via the in-service route should provide a summary 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 21: 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. For ETOPS, not less than 12 consecutive months experience will normally be required before authorisation of ETOPS up to 120 180 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.

Note 2: Each operator requesting Approval to conduct ETOPS beyond 180 minutes should already have ETOPS experience and hold a 180 minute ETOPS approval.

(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.(iii) 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.

(iv) Validation of Operator ETOPS Continued Airworthiness and Operations Capability

The operator should demonstrate competence to safely conduct and adequately support the intended operation. Prior to ETOPS approval, the operator should demonstrate that the ETOPS continuing airworthiness processes required by Part M are being properly conducted their usual departure and destination aerodromes.

The operator should also demonstrate that ETOPS flight dispatch release practices, policies, and procedures are established for operations to and from their usual departure and destination aerodromes.

An operational validation flight will be required, so that the operator can demonstrate dispatch and normal in-flight procedures. The content of this validation flight will be determined by the Authority based on the previous experience of the operator.

Upon successful completion of a validation flight, the operational specifications and manuals should be modified to include approval for ETOPS as applicable.

(v) ETOPS Operations Approval issued by the Authority

Operations approvals based on in-service experience are limited to those areas agreed by the Authority at time of issue. Additional approval is required for new areas to be added.

The approval issued by the Authority for ETOPS should specifically include provisions covering at least the following:

(A) Definition of the particular airframe/engine combinations, including the current approved CMP document required for ETOPS as normally identified in the AFM (CS 25.1535;)

(B) Authorised area of operation;

(C) Minimum altitudes to be flown along planned and diversionary routes;

(D) Operator's Approved Diversion Time.

(E) Aerodromes nominated for use, including alternates, and associated instrument approaches and operating minima;

(F) The approved maintenance and reliability programme for ETOPS;

(G) Identification of those aeroplanes designated for ETOPS by make and model as well as serial number and registration

(H) Define proposed routes and the ETOPS diversion time necessary to support those routes;

(I) The proposed one-engine-inoperative cruise speed, which may be area specific, depending upon anticipated aeroplane loading and likely fuel penalties associated with the planned procedures;

(J) Define processes and related resources being allocated to initiate and sustain ETOPS operations in a manner that demonstrates commitment by management and all personnel involved in ETOPS continued airworthiness and operational support;

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

~~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 paragraph are in addition to, or amplify, the operational requirements and specifically apply to extended range operations. Although many of the considerations in this AMC 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 operational requirements 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 3048 m (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 3048 m (10 000 feet) at the relevant one-engine-inoperative cruise speed or continued cruise above 3048 m (10 000 feet) if the aeroplane is equipped with sufficient supplemental oxygen in accordance with the operational requirements.~~

~~(C) Upon approaching the ETOPS en-route alternate, descent to 457 m (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 the operational requirements.

(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 Agency/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 3048 m (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 3048 m (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 the operational requirements.~~

~~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 and should be specified in the operator certificate issued by the appropriate Authority.~~

~~(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 have 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 3048 m (10 000 feet) or above 3048 m (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.~~

d. Types of ETOPS Approval

(1) Approval for 90 Minutes or less ETOPS

The Operators Approved Diversion Time is an operational limit that should not exceed the Maximum Approved Diversion Time and time-limited system capability minus 15 minutes (unless already included in manufacturer data).

If the airframe/engine combination does not yet have a Type Design approval for at least 90 minutes diversion time in accordance with the criteria in CS 25.1535, the aircraft should satisfy the following relevant ETOPS design requirements.

(i) Operations Approval

Consideration may be given to the approval of ETOPS 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 and the quality of the proposed continued airworthiness and operations programmes.

(ii) Continued Airworthiness

Maintenance and reliability programmes should be instituted which follow the guidance in EASA Part M and in this AMC.

(iii) Release Considerations

(A) Minimum Equipment List (MEL)

Aeroplanes should only be operated in accordance with the provisions of the approved Minimum Equipment List (MEL). MEL restrictions for 120 minutes ETOPS should be used unless there are specific restrictions for 90 minutes or less.

(B) 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 sufficient accuracy and reliability in the proposed area of operation.

(C) Fuel

Fuel should be sufficient to comply with the critical fuel scenario as described in AMC to Part M and in this AMC.

(iv) 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 to nominated ETOPS en-route alternates, the operator's programme should provide flight crews with information on Adequate Aerodromes on the route to be flown which are not forecast to meet the ETOPS 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.

(v) Flight Crew Training

(A) Contingency Procedures

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

(B) 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 potential operating contingencies.

(C) En-route Alternate

Appendix 5 to this AMC should be implemented when establishing the company operational procedures for ETOPS.

(2) Approval for 90 – 180 minutes ETOPS

Approval for 90-180 minutes ETOPS includes any Approval for 120 minutes ETOPS (and 138 minutes).
Each operator requesting Approval to conduct ETOPS beyond 90 minutes, and up to 180 minutes, may do so, based on either of the following:

- Accelerated approval in accordance with 10.c.(1) of this AMC;
- In-service approval in accordance with 10.c.(2) of this AMC.

Note: Prior to approval, the operator's capability to conduct operations and implement effective ETOPS programmes, in accordance with the criteria detailed in this AMC and the relevant appendices, will be examined.

The Operator's Approved Diversion Time is an operational limit that should not exceed the Maximum Approved Diversion Time specified in the Aeroplane Flight Manual, minus 15 minutes for cargo fire suppression systems.

(i) Continued Airworthiness

Maintenance or reliability programmes should be instituted which follow the guidance in EASA Part M and this AMC.

(ii) Release Considerations

(A) Minimum Equipment List (MEL)

The MEL should reflect adequate levels of system redundancy to support the planned operation. The systems listed in the Appendix 4 to this AMC in the MEL section should be considered.

(B) Weather

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

(C) Fuel

Fuel should be sufficient to comply with the critical fuel scenario as described in Appendix 4 to this AMC.

(iii) 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 to nominated ETOPS en-route alternates, the operator's programme should provide flight crews with information on Adequate Aerodromes on the route to be flown which are not forecast to meet the ETOPS 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.

(iv) Flight Crew Training

(A) Contingency Procedures

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

(B) 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 potential operating contingencies.

(C) En-route Alternate

Appendix 5 of this AMC (Sub- paragraph Alternate Aerodromes) should be implemented when establishing the company operational procedures.

(v) Communications Equipment (VHF/HF, Data Link)

For all routes where voice communication facilities are available, the communication equipment required by operational requirements should include at least one voice based system.

(vi) Additional Considerations for 120 minute Maximum Approved Diversion Times

In the case of an aircraft certified for 120 minutes ETOPS, small increases in the diversion time for specific routes may be approved, to a maximum of 138 minutes, if it can be shown that the resulting routing will not reduce the overall safety of the operation. In all cases the aeroplane time-limited systems and fuel carriage should support 138 minutes ETOPS.

Such increases will require:

(A) the Agency/Authority to assess overall type design including time-limited systems, demonstrated reliability; and

(B) the development of an appropriate MEL related to the diversion time required.

(vii) Additional Considerations for 180 minute Maximum Approved Diversion Times

On a case by case basis, for aircraft certified for 180 minutes ETOPS, small increases in the diversion time for specific routes may be approved, to a maximum of 207 minutes, if it can be shown that the resulting routing will not reduce the overall safety of the operation. In all cases the aeroplane time-limited systems and fuel carriage should support 207 minute ETOPS.

Such increases will require:

(A) the Agency/Authority to assess overall type design including time-limited systems, demonstrated reliability; and

(B) the development of an appropriate MEL related to the diversion time required.

(3) Approval for ETOPS above 180 minutes

Approval to conduct operations with diversion times exceeding 180 minutes may be granted to operators with previous ETOPS experience on the particular engine/airframe combination and an existing 180 minute ETOPS approval on the airframe/engine combination listed in their application.

Operators should minimise diversion time along the preferred track. Increases in diversion time by disregarding ETOPS adequate aerodromes along the route, should only be planned in the interest of the overall safety of the operation.

The approval to operate more than 180 minutes from an adequate aerodrome shall be area specific, based on the availability of adequate ETOPS en-route alternate aerodromes.

(i) Operating limitations

The Operator’s Approved Diversion Time is an operational limit that should not exceed the Maximum Approved Diversion Time.

In view of the long diversion time involved (above 180 minutes), the operator is responsible to ensure that on any given day in the forecast conditions, such as prevailing winds and temperature and applicable diversion and approach* procedures, a diversion to an ETOPS en-route Alternate will not exceed the:

(A) Engine-related time-limited systems capability at the approved one-engine-inoperative cruise speed; and

(B) Non engine-related time-limited system capability, such as cargo fire suppression, or other non engine-related system capability at the all engine operative cruise speed.

* Approach procedure needs not to be considered if the 15 minutes margin is already included in the time-limited systems capability

(ii) Communications Equipment (VHF/HF, Data Link and Satellite based communications)

Operators are required to use any or all of these forms of communications to ensure communications capability when operating ETOPS in excess of 180 minutes. For all routes where voice communication facilities are available, voice communications should be provided in the aeroplane.

(iii) Minimum Equipment List (MEL)

The MEL should reflect adequate levels of system redundancy to support the planned operation. The systems listed in the Appendix 4 to this AMC under MEL section should be considered.

(4) Approval for extended range operations with diversions times in excess of 180 (ETOPS) of operators of two-engined aeroplanes with a maximum approved passenger seating configuration of 19 or less and a maximum take-off mass less than 45 360 kg

(i) Type Design

The airframe/engine combination and engine should have the appropriate Type Design approval for the requested maximum diversion times in accordance with the criteria in CS 25.1535 and paragraph 8 'Type Design Approval Considerations for Eligibility' of this AMC.

(ii) Operations Approval

Approval to conduct operations with diversion times exceeding 180 minutes may be granted to operators with experience on the particular airframe/engine combination or existing ETOPS approval on a different airframe/engine combination, or equivalent experience. Operators should minimise diversion time along the preferred track and minimise operations where diversion times are in excess of 180 minutes or less whenever possible. The approval to operate more than 180 minutes from an adequate aerodrome shall be area specific, based on the availability of alternate aerodromes, the diversion to which would not compromise safety.

Note: Exceptionally for this type of aeroplanes, operators may use the accelerated, process driven, method to gain ETOPS approval. This method is described in 10 c.(1) above.

e. Operations Manual

Operations Manual material related to the conduct of ETOPS, and any subsequent amendments, are subject to approval by the Authority. The Authority will review in-service ETOPS experience. Amendments to the Operations Manual may be required as a result. Operators should provide information for and participate in such reviews, with reference to the manufacturer where necessary. The information resulting from these reviews should be used to modify or update flight crew training programmes, operations manuals and checklists, as necessary.

An example of an ETOPS Operations Manual Supplement is provided in Appendix 7 to this AMC.

f. Flight Preparation and In-Flight procedures

(1) An operator should establish pre-flight planning and dispatch procedures for ETOPS and they should be listed in the Operations Manual. These procedures should include, but not be limited to, the provision of forecast and actual weather and en-route and fuel planning, taking account of the critical fuel scenario.

(2) The procedures and manual should require that sufficient information is available for the aeroplane pilot in command, to satisfy himself that the status of the aeroplane and relevant airborne systems is appropriate for the intended operation. The manual should also include guidance on diversion decision-making and en-route weather monitoring.

An example is provided in the appendix 4 to this AMC – "Flight Preparation and In-Flight procedures"

g. Operational Limitations

The operational limitations to the area of operations and the Operator's Approved Diversion Time/Maximum Approved Diversion Time, are detailed in Appendix 3 to this AMC – "Operational Limitations".

h. ETOPS En-route Alternate Aerodromes

An operator shall select ETOPS En-route Alternates Aerodromes in accordance with the applicable operational requirements. Expanded guidance is available in Appendix 5 to this AMC - Route Alternate.

i. Initial/Recurrent Training

An operator should ensure that prior to conducting ETOPS, each crew member completes training and checking in accordance with a syllabus compliant with Appendix 7 to this AMC, approved by the Authority and detailed in the Operations Manual.
The qualification will be type and route-specific in accordance with the applicable operational requirements.

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~~ 2 and AMC to Part M. 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

1 ASSESSMENT PROCESS

To establish by utilising service experience whether a particular airframe/engine combination has satisfied the propulsion systems reliability requirements for ETOPS, an engineering assessment will be made by the Agency, using all pertinent propulsion system data. To accomplish the assessment, the Agency will need world fleet data (where available), and data from various sources [the operator, the engine ~~manufacturer~~ and ~~the~~ aeroplane ~~manufacturer~~ (S)TC holder] which should be extensive enough and of sufficient maturity to enable the Agency 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 Agency 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 ETOPS.

Alternatively, where type design approval for Early ETOPS is sought at entry into service, the engineering assessment can be based on substantiation by analysis, test, in service experience or other means, to show that the propulsion system will minimise failures and malfunctions and will achieve an IFSD rate that is compatible with the specified safety target associated with total loss of thrust.

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~~ Agency 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.

2 RELIABILITY VALIDATION METHODS

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 a design, analyses and test programmes, agreed between the (S)TC holders and the Agency/Authority. The extent to which a propulsion system is a derivative of previous ETOPS-rated systems is also a factor of the level of maturity. When considering the acceptability of a propulsion system, maturity should be assessed not only in terms of total fleet hours but also taking account of fleet leader time over a calendar time and the extent to which test data and design experience can be used as an alternative.

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 program 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 engine hours for new types and 50,000 engine hours for derivatives. 3,000 to 4,000 engine hours is considered to be the necessary time in service for a specific unit to indicate problem areas.

Normally, the in-service experience will be:

(1) For new propulsion systems: 100,000 engine hours and 12 months service. Where experience on another aeroplane is applicable, a significant portion of the 100,000 engine 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 engine 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) Aeroplane 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~~. See paragraph 3 'Risk Management and Risk Model'.

(3) Data Required for the Assessment

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

(A) date;

(B) airline;

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

(D) power-unit configuration and modification history;

(E) engine position;

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

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

(ii) 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):

(iii) Unscheduled engine removals/shop visit rates;

(iv) Total engine hours and aeroplane cycles;

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

(vi) Additional data as required;

(vii) The Agency will also consider relevant design and test data.

b. *Early ETOPS*

Where type design approval for Early ETOPS is sought at first entry into service the engineering assessment can be based on substantiation by analysis, test, in service experience or other means to show that the propulsion system will minimise failures and malfunctions, and will achieve an IFSD rate that is compatible with the specified safety target associated with catastrophic loss of thrust. An certification plan, defining the early ETOPS reliability validation tests and processes, must be submitted by the manufacturer to the Agency for agreement. This certification plan must be implemented and completed to the satisfaction of the Agency before an ETOPS type design approval will be granted for a propulsion system.

(i) Acceptable Early ETOPS certification plan;

(ii) Propulsion System Validation Test.

The propulsion system for which approval is being sought should be tested in accordance with the following schedule. The propulsion system for this test should be configured with the aeroplane installation nacelle and engine build-up hardware representative of the type certificate standards.

Tests of simulated ETOPS service operation and vibration endurance should consist of 3,000 representative service start-stop cycles (take-off, climb, cruise, descent, approach, landing and thrust reverse), plus three simulated diversions at maximum continuous thrust for the Maximum Approved Diversion Time for which ETOPS eligibility is sought. These diversions are to be approximately evenly distributed over the cyclic duration of the test, with the last diversion to be conducted within 100 cycles of the completion of the test.

This test must be run with the high speed and low speed main engine rotors unbalanced to generate at least 90 percent of the applicant's recommended maintenance vibration levels. Additionally, for engines with three main engine rotors, the intermediate speed rotor must be unbalanced to generate at least 90 percent of the applicant's recommended acceptance vibration level. The vibration level shall be defined as the peak level seen during a slow accel/decel of the engine across the operating speed range. Conduct the vibration survey at periodic intervals throughout the 3000 cycle test. The average value of the peak vibration level observed in the vibration surveys must meet the 90% minimum requirement. Minor adjustments in the rotor unbalance (up or down) may be necessary as the test progresses, in order to meet the required average vibration level requirement. Alternatively, to a method acceptable to the Agency, an applicant may modify their test to accommodate a vibration level marginally less than 90% or greater than 100% of the vibration level required in lieu of adjusting rotor unbalance as the test progresses.

Each one hertz (60 rpm) bandwidth of the high speed rotor service start-stop cycle speed range (take-off, climb, cruise, descent, approach, landing and thrust reverse) must be subjected to $3x10^6$ vibration cycles. An applicant may conduct the test in any rotor speed step increment up to 200 rpm as long as the service start-stop cycle speed range is covered. For a 200 rpm step the corresponding vibration cycle count is to be 10 million cycles. In addition, each one hertz bandwidth of the high speed rotor transient operational speed range between flight idle and cruise must be subjected to $3x10^5$ vibration cycles. An applicant may conduct the test in any rotor speed step increment up to 200 rpm as long as the transient service speed range is covered. For a 200 rpm step the corresponding vibration cycle count is to be 1 million cycles.

At the conclusion of the test, the propulsion system must be:

(i) Visually inspected according to the applicant's on-wing inspection recommendations and limits.

(ii) Completely disassembled and the propulsion system hardware must be inspected in accordance with the service limits submitted in compliance with relevant instructions for continued airworthiness. Any potential sources of in-flight shutdown, loss of thrust control, or other power loss encountered during this inspection must be tracked and resolved in accordance with paragraph 5 of this Appendix 1.

~~c.~~3 RISK MANAGEMENT AND RISK MODEL

Propulsion systems approved for ETOPS must be sufficiently reliable to assure that defined safety targets are achieved.

a. For ETOPS with a Maximum Approved Diversion Time of 180 minutes or less

An early 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 0·3 x 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 0·3 x 10^{-6} per flying hour has therefore been chosen ~~as the all causes safety target~~ as the safety target for ETOPS approvals up to 180 minutes.

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 0·3 x 10^{-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 0·3 x 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 Agency that after application of the corrective actions identified during the engineering assessment (see Appendix 1, paragraph ~~1.d.~~ 4), 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.

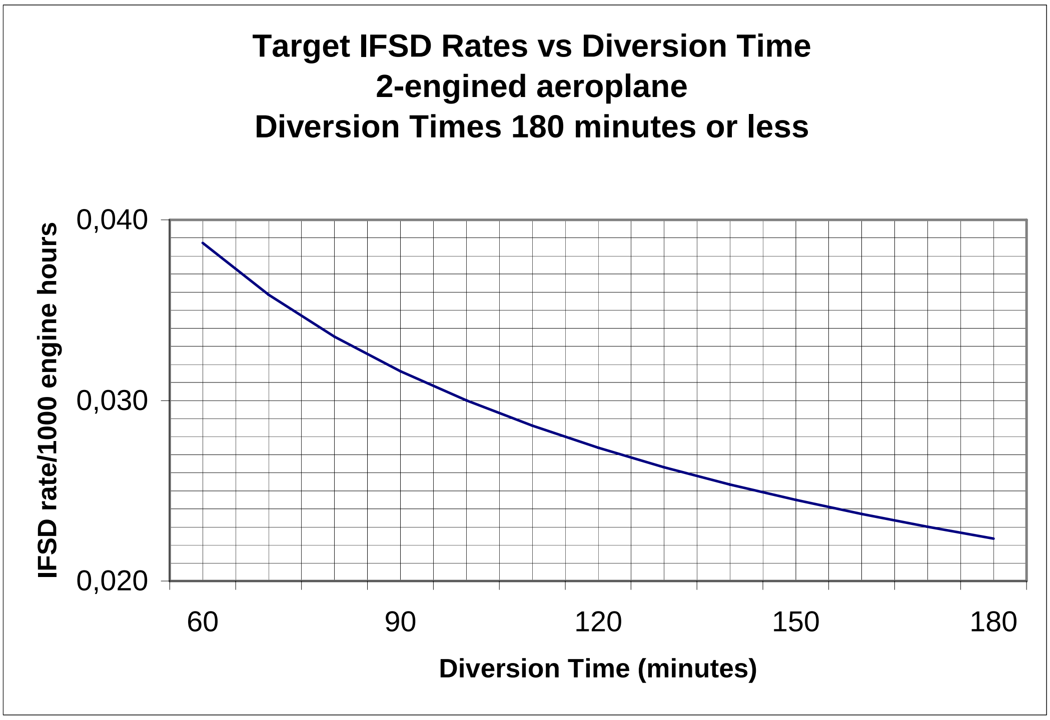


Figure 1

b. For ETOPS with a Maximum Approved Diversion Time of greater than 180 minutes

The propulsion systems IFSD rate target should be compatible with the objective that the catastrophic loss of thrust from independent causes is no worse than Extremely Improbable, based on maximum ETOPS flight duration and maximum ETOPS rule time.

For ETOPS with Maximum Approved Diversion Times greater than 180 minutes, to meet this objective that the powerplant installations must comply with the safety objectives of CS 25.1309, the goal should be that the catastrophic loss of thrust from independent causes should be Extremely Improbable (EI) (see AMC 25.1309). The defined target for ETOPS approvals with diversion times of 180 minutes or less, for catastrophic loss of thrust from independent causes, is $0.3x10^{-8/}$hr. (see paragraph 3 of this Appendix). This target was based on engine IFSD rates that were higher than can be and are being achieved by modern ETOPS airframes/engines. To achieve the same level of safety for ETOPS approvals beyond 180 minutes as has been achieved for ETOPS approvals of 180 minutes or less, the propulsion system reliability IFSD rate target needs to be set and maintained at a level that is compatible with an EI safety objective (i.e. $1.0x10^{-9}$ /flight hr).

For example, a target overall IFSD rate of 0.01/1000 hr. (engine hours) that is maintained, would result in the loss of all thrust on two engine aeroplanes being Extremely Improbable even assuming the longest time envisaged. The risk model formula summarised for a two engine aeroplane is :

p/flight hour = [2(Cr x{T-t}) x Mr(t)] divided by T

(1) p is the probability of a dual independent propulsion unit failure on a twin,

(2) 2 is the number of opportunities for an engine failure on a twin (2),

(3) Cr is cruise IFSD rate (0.5x overall rate), Mr is max continuous IFSD rate (2x overall rate), T is planned max flight duration in hours (departure to planned arrival airport), and t is the diversion or flight time in hours to a safe landing. IFSD rates, based on engine manufacturers' historical data from the last ten years of modern large turbofan engines, presented to the JAA/EASA and ARAC ETOPS working groups have shown cruise IFSD rates to be of the order of 0.5x overall rate, and the max continuous IFSD rate (estimated from engine fleet analysis) to be 2x overall rate. Then, for an IFSD goal of .010/1000EFH overall, the cruise IFSD rate is .005/1000EFH, and the max continuous rate is .020/1000EFH.

(4) Sample calculation (max flight case scenario): assume T = 20 hour max flight duration, an engine failure after 10 hours, then continued flight time required is t = 10 hours, using the ETOPS IFSD goal of .010/1000EFH or less, results in a probability of p=1 E-9/hour (i.e. meets Extremely Improbable safety objective from independent causes).

(5) A relationship between target IFSD rate and diversion times for two engine aeroplanes is shown in Figure 2.

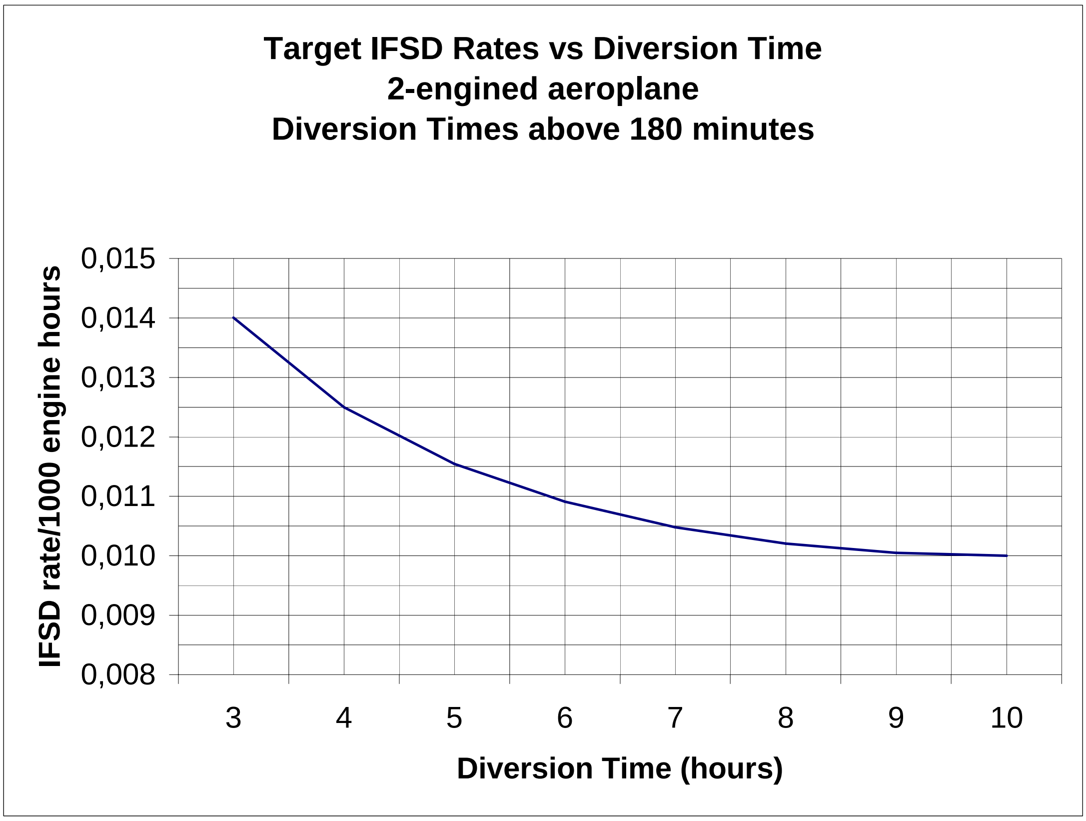


Figure 2

d.4 ENGINEERING ASSESSMENT. CRITERIA FOR ACCEPTABLE RELIABILITY VALIDATION METHODS

The following criteria identify some areas to be considered during the engineering assessment required for either reliability validation method.

a. 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 shut down rate will be established, for use in determining whether a particular airframe/engine combination complies with criteria for extended range operation.

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

(1) 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;

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

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

(4) Maintenance actions recommended and performance and their effect on propulsion system and APU failure rates;

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

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

c. Engineering judgement will be used in the analysis of paragraph ~~1.d.(2)~~ 4.b. above, such that the potential improvement in reliability, following the introduction of corrective actions identified during the analysis, can be quantified.

d. The resultant predicted reliability level and the criteria developed in accordance with paragraph ~~1.c~~ 3 should together be used to determine the maximum diversion time for which the particular airframe/engine combination qualifies.

e. The type design standard for type approval of the airframe/engine combination, and the engine, for ~~extended range operations~~ ETOPS will include all modifications and maintenance actions for which full or partial credit is taken ~~in paragraph 5.3~~ by the (S)TC holder and other ~~such~~ actions required by the Agency to enhance reliability. The schedule for incorporation of type design standard items should normally be established in the Configuration, Maintenance and Procedures (CMP) document for example in terms of calendar time, hours or cycles.

f. When ~~a foreign manufacturer's~~ third country (S)TC holders' and/or third country operator's data are evaluated, the respective foreign ~~Airworthiness~~ Authorities will be offered ~~the opportunity~~ to participate in the assessment.

g. Propulsion System Reliability Assessment Board (PSRAB)'s Findings.

Once an assessment has been completed and the PSRAB has documented its findings, he Agency will declare whether or not the particular airframe/engine combination and engine satisfy the relevant considerations of this AMC. Items recommended qualifying the propulsion system, such as maintenance requirements and limitations will be included in the Assessment Report (paragraph 8 ~~e~~g. of this AMC).

h. In order to establish that the predicted propulsion system reliability level is achieved and subsequently maintained, the (S) TC holder should submit to the Agency 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.

5 EARLY ETOPS OCCURRENCES REPORTING & TRACKING

a. The holder of a (supplemental) type certificate of an engine, which has been approved for ETOPS without service experience in accordance with this AMC, should establish a system to address problems and occurrences encountered on the engine that could affect the safety of operations and timely resolution.

b. The system should contain a means for: the prompt identification of ETOPS related events, the timely notification of the event to the Agency, proposing a resolution of the event and obtaining Agency's approval. The implementation of the problem resolution can be accomplished by way of Agency approved change(s) to the type design, the manufacturing process, or an operating or maintenance procedure.

c. The reporting system should be in place for the first 250,000 fleet engine hours. The reporting requirement remains in place until the fleet has demonstrated a stable in-flight shut down rate in accordance with the targets defined in this Appendix 1.

d. For the early ETOPS service period, an applicant must define the sources and content of the service data that will be made available to them in support of their occurrence reporting and tracking system. The content of this data should be adequate to evaluate the specific cause of all service incidents reportable under Part 21A.3(c), in addition to the occurrences that could affect the safety of operations, and should be reported, including:

(1) In-flight shut down events and rates;

(2) Inability to control the engine or obtain desired power;

(3) Precautionary thrust reductions (except for normal troubleshooting as allowed in the aircraft flight manual);

(4) Degraded propulsion in-flight start capability;

(5) Inadvertent fuel loss or availability in flight;

(6) Unscheduled engine removals for conditions that could result in one of the reportable items listed above.

~~e.~~6 CONTINUING AIRWORTHINESS

For ETOPS, the Agency will periodically review its original findings by means of a Reliability Tracking Board. In addition, the Agency document containing the CMP standard will be revised as necessary.

Note: The Reliability Tracking Board will usually comprise specialists from aeroplane and engine disciplines. (See also Appendix 2)

Periodic meetings of the ETOPS Reliability Tracking Board are normally frequent at the start of the assessment of a new product. The periodicity is adjusted by the Agency 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 Agency.

Note: The overall engine IFSD rate should be viewed as a world-fleet average target figure of engine reliability (representative of the airframe/engine combination being considered) and if exceeded, may not, in itself, trigger action in the form of a change to the ETOPS design standard or a reduction in the ETOPS approval status of the engine. The actual IFSD rate and its causes should be assessed with considerable engineering judgement. For example, a high IFSD rate early after the commencement of the operation may be due to the limited number of hours contributing to the high rate. There may have been only one shut down. The underlying causes have to be considered carefully. Conversely, a particular single event may warrant corrective action implementation, even though the overall IFSD rate objective is being achieved.

~~(1)~~a. Mature ETOPS products

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

(~~i~~1) The product family has accumulated at least 250,000 flight hours for an aeroplane family or 500,000 operating hours for an engine family;

(~~ii~~2) The product family has accumulated service experience covering a comprehensive spectrum of operating conditions (e.g. cold, hot, high, and humid);

(~~iii~~3) 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 ~~a here before~~ above 6.a.

The ~~Reliability Tracking Board Chairman and the Project Certification Manager~~ Agency makes the determination of when a product or a product family is considered mature.

~~(2)~~b. Surveillance of mature ETOPS products

The ~~Manufacturer~~ (S)TC holder of an ETOPS product which the Agency has found mature, should institute a process to monitor the reliability of the product in accordance with the objectives defined in this Appendix 1. In case of occurrence of an event or 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 AMC, the ~~Manufacturer~~ (S)TC holder should:

(~~i~~1) Inform the Agency and define a means to restore the reliability through a Minor Revision of the CMP document, with a compliance schedule to be agreed with the Agency if the situation has no immediate safety impact;

(~~ii~~2) Inform the Agency and propose an ad-hoc follow-up by the Agency until the concern has been alleviated or confirmed if the situation requires further assessment;

(~~iii~~3) Inform the Agency and propose the necessary corrective action(s) to be mandated by the Agency through an AD if a direct safety concern exists.

In the absence of a specific event or trend requiring action, the ~~Manufacturer~~ (S)TC holder should provide the Agency with the basic statistical indicators prescribed in this Appendix 1 on a yearly basis.

~~(3)~~c. 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 Agency, or new reliability improvements which have no immediate impact on the safety of ETOPS flights and which are introduced as a means to control the continued compliance with the reliability objectives of ETOPS.
Minor revisions of the ETOPS CMP document ~~may~~ should be approved by ~~designated~~ authorised signatories personnel of the ~~Manufacturer~~ (S)TC holder under the provisions of its approved Design Organisation Handbook.

7 DESIGN ORGANISATION APPROVALS

~~Manufacturers of products approved for ETOPS should hold a Design Organisation Approval (DOA) conforming to PART 21. Their approved Design Organisation Handbook (DOH) must contain appropriate organisation and procedures covering the tasks and responsibilities of this AMC.~~
~~Foreign manufacturers not approved as a EASA DOA must present an equivalent organisation and procedures that satisfies the intent of this paragraph. For example, the equivalent FAA FAR 21 approval process is considered acceptable.~~

(Supplemental) Type Certificate holders of products approved for ETOPS should hold a Design Organisation Approval (DOA) conforming to EASA Part 21, with the appropriate terms of approval and privileges. Their approved Design Organisation Handbook (DOH) must contain an appropriate description of the organisation and procedures covering all applicable tasks and responsibilities of EASA Part 21 and this AMC.

Third country (S)TC holders, not holding an EASA DOA must present proof of at least an equivalent organisation and a hand book containing procedures that satisfies the intent of EASA Part 21 and this EASA AMC 20-6.

APPENDIX 2 - AIRCRAFT SYSTEMS RELIABILITY ASSESSMENT

1 ASSESSMENT PROCESS

The intent of this Appendix is to provide additional clarification to paragraphs 8bd, 8ce,(1) and 7.f.(4) of this AMC. 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 Agency, using all pertinent systems data provided by the applicant. To accomplish this assessment, the Agency will need world-fleet data (where available) and data from various sources (the operators, aeroplane manufacturer (S)TC holder the equipment and equipment manufacturers original equipment manufacturers (OEM)). This data should be extensive enough and of sufficient maturity to enable the Agency to assess with a high level of confidence, using engineering and operational judgement, 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 Agency will declare whether or not the current system reliability of a particular airframe/engine combination satisfies the relevant criteria.

Included in the declaration, if the operation is approved, 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.

Alternatively, where type design approval for Early ETOPS is sought at first entry into service, the engineering assessment can be based on substantiation by analysis, test, in-service experience or other means to show that the airframe significant systems will minimise failures and malfunctions, and will achieve a failure rate that is compatible with the specified safety target

2 SYSTEM SAFETY ASSESSMENT 'SSA' (including reliability analysis)

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 Agency.

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 25.1309-1 and specific ETOPS requirements in this AMC (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 must 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 AMC.~~

~~(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 must 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) must be indicated for each equipment of an ETOPS significant system.~~

~~Where related service experience is used to validate failure modes and rates, an analysis must be produced to show the validity of the service experience.~~

~~In particular, if the same equipment is used on a different aircraft type, it must 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 must 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 must be agreed with the Agency.~~

~~(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 (S) TC holder should monitor the reliability of airframe (ETOPS significant) systems after entry into service. The manufacturer should submit a report to the Agency 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 Agency (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.~~

The System Safety Assessment (SSA) which should be conducted in accordance with CS 25.1309 for all ETOPS significant systems, should follow the steps below:

a. 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:

(1) Crew workload over a prolonged period of time;

(2) Operating conditions at single engine altitude;

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

b. Introduce any additional failure scenario/objectives necessary to comply with this AMC.

c. The functional hazard assessment for ETOPS significant systems should determine which are Group 1 and Group 2 and assure that the reliability of such systems is sufficient, in direct relationship with the consequences of their potential malfunctions, during the missions. For the analyses of Group 1 ETOPS significant systems, consider the maximum normal flight duration and maximum ETOPS diversion time. For the analyses of Group 2 ETOPS significant systems, consider the average ETOPS fleet mission length. Consideration should be given to how the particular airframe/engine combination is to be utilised, and analyse the potential route structure and city pairs available, based upon the range of the aeroplane.

d. Consider effects of prolonged time and at single engine altitude in terms of continued operation of remaining systems following failures.

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

f. Safety assessments should consider the flight consequences of single or multiple system failures leading to a diversion and the probability and consequences of subsequent failures or exhaustion of the capacity of time critical systems, which might occur during the diversion.
Safety assessments should determine whether a diversion should be conducted to the nearest aerodrome or to an aerodrome presenting better operating conditions, considering:

(1) The effect of the initial failure condition on the capability of the aeroplane to cope with adverse conditions at the diversion aerodrome, and
(2) The means available to the crew to assess the extent and evolution of the situation during a prolonged diversion.

The aircraft flight manual and the flight crew warning and alerting and display systems should provide clear information to enable the flight crew to determine when failure conditions are such that a diversion is necessary.

3 RELIABILITY VALIDATION METHODS

There are two extremes in the ETOPS process with respect to maturity; one is the demonstration of stable reliability by the accumulation of in-service experience and the other is by a design, analyses and test programmes, agreed between the (S)TC holders and the Agency/Authority.

a. In-s*ervice Experience/Systems Safety Assessment (SSA)*

In-service experience should generally be in accordance with that identified in Appendix 1 for each airframe/engine combination. When considering the acceptability of airframe systems for ETOPS, maturity should be assessed in terms of used technology and the particular design under review.
In performing the SSA's, defined in paragraph 2 of this Appendix 2, particular account will be taken of the following:

(1) For identical or similar equipment to those used on other aeroplanes, the SSA failure rates should be validated by in-service experience:

(i) The amount of in-service experience (either direct or related) should be indicated for each equipment of an ETOPS significant system.

(ii) Where related experience is used to validate failure modes and rates, an analysis should be produced to show the validity of the in-service experience.

(iii) In particular, if the same equipment is used on a different airframe/engine combination, it should be shown that there is no difference in operating conditions (e.g., vibrations, pressure, temperature) or that these differences do not adversely affect the failure modes and rates.

(iv) If in-service experience with similar equipment on other aeroplanes is claimed to be applicable, an analysis should 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 in-service experience of the similar equipment and details of any "lessons learnt" from modifications introduced and included in the new equipment.

(v) For certain equipment, (e.g., IDGs, TRUs, bleeds and emergency generators) this analysis may have to be backed up by tests. This should be agreed with the Agency.

(2) For new or substantially modified equipment, account should 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 the subject equipment.

Should a failure case probability be sensitive to this equipment failure rate and close to the required safety objective, particular provision precautions should 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 in-service experience.

b. Early ETOPS

Where type design approval for Early ETOPS is sought at first entry into service of the airframe/engine combination, the engineering assessment can be based on substantiation by analysis, test, in-service experience (the same engine or airframe with different engines) or other means, to show that the ETOPS significant systems will achieve a failure rate that is compatible with the specified safety objective. An certification plan, defining the early ETOPS reliability validation tests and processes, should be submitted by the (S)TC's holders to the Agency for agreement. This certification plan should be completed and implemented to the satisfaction of the Agency before an ETOPS type design approval will be granted.

(1) Acceptable Early ETOPS certification plan

In addition to the above considerations, the following should be complied with for an Early ETOPS approval.

(i) Aeroplane Testing

For each airframe/engine combination that has not yet accumulated at least 15,000 engine hours in service, to be approved for ETOPS, one or more aeroplanes should conduct flight testing which demonstrates that the airframe/engine combination, its components and equipment are capable for, and function properly, during ETOPS flights and ETOPS diversions. These flight tests may be coordinated with, but they are not in place of flight testing required in Part 21.35(b)(2).

The flight test programme should include:

(A) Flights simulating actual ETOPS operation, including normal cruise altitude, step climbs and APU operation if required for ETOPS;

(B) Demonstration of the maximum normal flight duration with the maximum diversion time for which eligibility is sought;

(C) Engine inoperative maximum time diversions to demonstrate the aeroplane and propulsion system's capability to safely conduct an ETOPS diversion, including a repeat of a MCT diversion on the same engine;

(D) Non-normal conditions to demonstrate the aeroplane's capability to safely conduct an ETOPS diversion under worst case probable system failure conditions;

(E) Diversions into representative operational diversionary airports;

(F) Repeated exposure to humid and inclement weather on the ground followed by long range operations at normal cruise altitude;

(G) The flight testing should validate the adequacy of the aeroplane's flying qualities, performance and flight crew's ability to deal with the conditions of paragraphs (C)/(D)&(E) above.

(H) The engine-inoperative diversions must be evenly distributed among the number of engines in the applicant's flight test programme except as required by paragraph (C) above.

(I) The test aeroplane(s) must be operated and maintained using the recommended operations and maintenance manual procedures during the aeroplane demonstration test.

(J) At the completion of the aeroplane(s) demonstration testing, the ETOPS significant systems must undergo an aeroplane visual inspection per the Instructions for Continued Airworthiness of CS 25.1529. The engines must also undergo a gas path inspection. These inspections are intended to identify any abnormal conditions that could result in an in-flight shutdown or diversion. Any abnormal conditions must be identified, tracked and resolved in accordance with subpart (2) below.

(K) Maintenance and Operational Procedures. The applicant must validate all ETOPS significant systems maintenance and operational procedures. Any problems found as a result of the validation must be identified, tracked and resolved in accordance with paragraph subpart (2) below.

(ii) APU Testing.

If an APU is required for ETOPS, one APU of the type to be certificated with the aeroplane should complete a test consisting of 3000 equivalent aeroplane operational cycles. Following completion of the demonstration test, the APU must be disassembled and inspected. Any potential sources of in-flight start and/or run events should be identified, tracked and resolved in accordance with paragraph subpart (2) below.

(2) Early ETOPS Occurrence Reporting & Tracking

(i) The holder of a (S)TC of an aeroplane which has been approved for ETOPS without service experience in accordance with this AMC, should establish a system to address problems an occurrences encountered on the airframe and propulsion systems that could affect the safety of ETOPS operations and timely resolution for these events;

(ii) The system should contain a means for the prompt identification of ETOPS related events, the timely notification of the event to the Agency and proposing to, and obtaining Agency's approval for the resolution of this event. The implementation of the problem resolution can be accomplished by way of an Agency approved change(s) to the type design, the manufacturing process, or an operating or maintenance procedure.

(iii) The reporting system should be in place for the first 250,000 flight hours. The reporting requirement remains in place until the airframe and propulsion systems have demonstrated stable reliability in accordance with the required safety objectives

(iv) If the airframe/engine combination certified is a derivative of a previously certificated aeroplane, these criteria may be amended by the Agency, to require reporting on only those changed systems.

(v) For the early ETOPS service period, an applicant must define the sources and content of in-service data that will be made available to them in support of their occurrence reporting and tracking system. The content of this data should be adequate to evaluate the specific cause of all service incidents reportable under PART 21.A.3(c), in addition to the occurrences that could affect the safety of ETOPS operations and should be reported, including:

(A) In-flight shutdown events;

(B) Inability to control the engine or obtain desired power;

(C) Precautionary thrust reductions (except for normal troubleshooting as allowed in the Aircraft Flight Manual);

(D) Degraded propulsion in-flight start capability;

(E) Inadvertent fuel loss or availability, or uncorrectable fuel imbalance in flight;

(F) Technical air turn-backs or diversions associated with an ETOPS Group 1 system;

(G) Inability of an ETOPS Group 1 system, designed to provide backup capability after failure of a primary system, to provide the required backup capability in-flight;

(H) Any loss of electrical power or hydraulic power system, during a given operation of the aeroplane;

(I) Any event that would jeopardise the safe flight and landing of the aeroplane during an ETOPS flight.

4 CONTINUING SURVEILLANCE

In order to confirm that the predicted system reliability level is achieved and maintained, the (S)TC holder should monitor the reliability of airframe ETOPS significant systems after entry into service. The (S)TC's holder should submit a report to the Agency, 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 Agency. The monitoring task should include all events on ETOPS significant systems, both on the 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 ETOPS Group 1 systems.

5 CONTINUING AIRWORTHINESS

a. The Agency will periodically review its original findings by means of a Reliability Tracking Board. In addition, the Agency document containing the CMP standard will be revised as necessary.

Note: The Reliability Tracking Board will usually comprise specialists from aeroplane and engine disciplines. (See also Appendix 1).

Periodic meetings of the ETOPS Reliability Tracking Board are normally frequent at the start of the assessment of a new product. The periodicity is adjusted by the Agency upon accumulation of substantial in-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 Agency.

b. Mature ETOPS products

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

(1) The product family has accumulated at least 250,000 flight hours for an aeroplane family;

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

(3) 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 conditions specified above.

The Agency makes the determination of when a product or a product family is considered mature.

c. Surveillance of mature ETOPS products

The (S)TC holder of an ETOPS product which the Agency has found mature, should institute a process to monitor the reliability of the product in accordance with the objectives defined in this Appendix 2. In case of occurrence of an event, 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, the (S)TC should:

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

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

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

In the absence of a specific event or trend requiring action, the (S)TC holder should provide the Agency with the basic statistical indicators prescribed in this Appendix 2 on a yearly basis.

d. 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 Agency, or new reliability improvements which have no immediate impact on the safety of ETOPS flights and which are introduced as a means to control the continued compliance with the reliability objectives of ETOPS.

Minor revisions of the ETOPS CMP document should be approved by authorised signatories of the Design Organisation and under the provisions of its approved Design Organisation Handbook.

6 DESIGN ORGANISATION APPROVAL

(Supplemental) Type Certificate holders of products approved for ETOPS should hold a Design Organisation Approval (DOA) conforming to EASA Part 21, with the appropriate terms of approval and privileges. Their approved Design Organisation Handbook (DOH) must contain an appropriate description of the organisation and procedures covering all applicable tasks and responsibilities of EASA Part 21 and this AMC.

Third country (S)TC holders, not holding an EASA DOA must present proof of at least an equivalent organisation and a hand book containing procedures that satisfies the intent of EASA Part 21 and this EASA AMC 20-6.

APPENDIX 3 - ~~SUITABLE EN-ROUTE ALTERNATE~~ AERODROMES OPERATIONAL LIMITATIONS

~~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 AMC, 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 122 m (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 61 m (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~~	~~at least 2 separate approach procedures based on 2 separate aids serving 1 runway~~	~~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 must 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).~~

1. AREA OF OPERATION

An operator is, when specifically approved, authorised to conduct ETOPS flights within an area where the diversion time, at any point along the proposed route of flight, to an Adequate ETOPS en-route alternate Aerodrome, is less than the Operator's Approved Diversion Time (under standard conditions in still air) at the approved one-engine-inoperative cruise speed.

2. OPERATOR'S APPROVED DIVERSION TIME

The Operator's Approved Diversion Time is an operational limit that will always be equal to or less than either the Maximum Approved Diversion Time, or the maximum diversion time based on the MEL generated serviceability status of the aeroplane, whichever is shorter.

The Operator's Approved Diversion Time to an Adequate ETOPS en-route alternate Aerodrome at the approved one-engine-inoperative cruise speed (under standard conditions in still air) is normally be the limiting factor to allow operation on preferred tracks in a specific area.

3. USE OF MAXIMUM DIVERSION TIME

The procedures established by the operator should ensure, that ETOPS is limited to flight plan routes where the Operator's Approved Diversion Time to an Adequate ETOPS en-route alternate

Aerodrome can be met (under standard conditions in still air) at the approved one-engine-inoperative cruise speed.

In addition, for operations with Operator's Approved Diversion Times above 180 minutes, the operator should check that the planned diversion time will not exceed, either the Maximum Approved Diversion Time (System Limit) minus 15 minutes, or the maximum diversion time based on the MEL generated serviceability status of the aeroplane minus 15 minutes, whichever is shorter. These checks should be calculated with the associated predicted speed and altitude conditions.

APPENDIX 4 - ETOPS MAINTENANCE REQUIREMENTS FLIGHT PREPARATION AND IN-FLIGHT PROCEDURES

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 other 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.

1. GENERAL

The flight release considerations specified in this paragraph are in addition to the applicable operational requirements. They specifically apply to ETOPS. Although many of the considerations in this AMC are currently incorporated into approved programmes for other aeroplanes or route structures, the unique nature of ETOPS necessitates a re-examination of these operations to ensure that the Approved programmes are adequate for this purpose.

2. MINIMUM EQUIPMENT LIST (MEL)

The system redundancy levels appropriate to ETOPS 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 ETOPS operation proposed, equipment and in-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:

a. electrical, including battery;
b. hydraulic;
c. pneumatic;

d. flight instrumentation, including warning and caution systems;
e. fuel;
f. flight control;
g. ice protection;
h. engine start and ignition;
i. propulsion system instruments;
j. navigation and communications, including any route specific long range navigation and communication equipment;
k. auxiliary power-unit;
l. air conditioning and pressurisation;
m. cargo fire suppression;
n. engine fire protection;
o. emergency equipment;
p. all systems and equipment supplied from the standby/emergency electrical power source.

In addition, the following systems are required to be operative for dispatch for ETOPS with diversion times above 180 minutes:

a. Fuel Quantity Indicating System (FQIS);

b. APU (including electrical and pneumatic supply to its designed capability);

c. Automatic engine or propeller control system;

d. Communication system(s) relied on by the flight crew to comply with the requirement for communication capability.

3. COMMUNICATION AND NAVIGATION FACILITIES

For releasing an aeroplane on an ETOPS flight, the operators should ensure that:

a. Communications facilities are available to provide under normal conditions of propagation at all planned contingency altitudes, reliable two-way voice and/or data link communications between the aeroplane and the appropriate air traffic service unit over the planned route to be flown and the routes to any suitable or designated alternate to be flown in the event of diversion;
b. 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 to be flown, and the routes to any alternate and altitudes to be flown in the event of engine shutdown; and
c. Visual and non-visual aids are available at the specified alternates for the anticipated types of approaches and operating minima.

4. FUEL SUPPLY

a. General

For releasing an aeroplane on an ETOPS flight, the operators should ensure that it carries sufficient fuel and oil to meet the applicable operational requirements and any additional fuel that may be determined in accordance with this Appendix.

b. Critical Fuel Reserve

In establishing the critical fuel reserves, the applicant is to determine the fuel necessary to fly to the most critical point (at normal cruise speed and altitude, taking into account the anticipated meteorological conditions for the flight) and execute a diversion to an ETOPS en-route Alternate under the conditions outlined in this Appendix, the 'Critical Fuel Scenario' (paragraph c. below).

These critical fuel reserves should be compared to the normal applicable operational 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 requirements, additional fuel should be included to the extent necessary to safely complete the Critical Fuel Scenario. When considering the potential diversion distance flown account should be taken of the anticipated routing and approach procedures, in particular any constraints caused by airspace restrictions or terrain.

c. 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.

Note1: If an APU is a required power source, then its fuel consumption should be accounted for during the appropriate phases of flight.
Note2: Additional fuel consumptions due to any MEL or CDL items should be accounted for during the appropriate phases of flight, when applicable.

The aeroplane is required to carry sufficient fuel taking into account the forecast wind and weather to fly to an ETOPS route alternate assuming the greater of:

(1) A rapid decompression at the most critical point followed by descent to a 10,000ft or a higher altitude if sufficient oxygen is provided in accordance with the applicable operational requirements.
(2) Flight at the approved one-engine-inoperative cruise speed assuming a rapid decompression and a simultaneous engine failure at the most critical point followed by descent to a 10,000ft or a higher altitude if sufficient oxygen is provided in accordance with the applicable operational requirements.
(3) Flight at the approved one-engine-inoperative cruise speed assuming an engine failure at the most critical point followed by descent to the one-engine-inoperative cruise altitude.

Upon reaching the alternate hold at 1500 ft above field elevation for 15 minutes and then conduct an instrument approach and landing.

Add a 5% wind speed factor (i.e., an increment to headwind or a decrement to tailwind) on the actual forecast wind used to calculate fuel in the greater of (1), (2) or (3) above to account for any potential errors in wind forecasting. If an operator is not using the actual forecast wind based on wind model acceptable to the Authority, allow 5% of the fuel required for (1), (2) or (3) above, as reserve fuel to allow for errors in wind data. A wind aloft forecasting distributed worldwide by the World Area Forecast System (WAFS) is an example of a wind model acceptable to the Authority.

d. Icing

Compensate in the greater of (1), (2) or (3) above for the greater of:

(1) the effect of airframe icing during 10 percent of the time during which icing is forecast (including ice accumulation on unprotected surfaces, and the fuel used by engine and wing anti-ice during this period).

(2) fuel for engine anti-ice, and if appropriate wing anti-ice for the entire time during which icing is forecast.

Note: Unless a reliable icing forecast is available, icing may be presumed to occur when the total air temperature (TAT) at the approved one-engine-inoperative cruise speed is less than +10ºC, or if the outside air temperature is between 0ºC and -20ºC with a relative humidity (RH) of 55% or greater.

The operator should have a programme established to monitor aeroplane in-service deterioration in cruise fuel burn performance and including in the fuel supply calculations sufficient fuel to compensate for any such deterioration. If there is no data available for such a programme the fuel supply should be increased by 5% to account for deterioration in cruise fuel burn performance.

5. ALTERNATE AERODROMES

To conduct an ETOPS flight, the required take-off, destination alternate aerodromes, including ETOPS en-route Alternate aerodromes, should meet the weather requirements of planning minima for IFR flights for an ETOPS en-route alternate contained in the applicable operational requirements. The planned en-route alternates for using in the event of propulsion system failure or aeroplane system failure(s) which require a diversion should be listed in the cockpit documentation (e.g. computerised flight plan).

Where departure or destination aerodromes are selected as ETOPS en-route alternate, they should meet the weather requirements of planning minima for IFR flights for an ETOPS en-route alternate contained in the applicable operational requirements, unless the critical fuel scenario includes additional fuel to continue the diversion from the departure or destination aerodrome to an alternate aerodrome meeting the weather requirements of planning minima for destination and destination alternate aerodromes for the available instrument approach which is contained in the applicable operational requirements.

See also Appendix 5 to this AMC ‘ETOPS En-route Alternate Aerodromes’.

ETOPS en-route alternates should also be identified and listed in operational flight plan for all cases where the planned route to be flown contains a point more than the applicable (ETOPS) threshold time at the one-engine-inoperative speed from an adequate aerodrome.

6. IN-FLIGHT RE-PLANNING AND POST-DISPATCH WEATHER MINIMA

An aeroplane whether or not dispatched as an ETOPS flight may not re-route post dispatch without meeting the applicable operational requirements and satisfy by an approved procedure that dispatch criteria have been met. The operator should have a system in place to facilitate such re-routes.

Post-dispatch, weather conditions at the ETOPS en-route alternates should be equal to or better than the minima for the available instrument approach.

7. DELAYED DISPATCH

If the dispatch of a flight is delayed by more than one hour, after the operating crew have left the briefing facility, operations support personnel should monitor weather forecasts for the nominated en-route alternates to ensure that they stay within the specified planning minima requirements until dispatch.

8. DIVERSION DECISION MAKING

Operators shall establish procedures for flight crew, outlining the criteria that indicate a diversion or change of routing whilst conducting an ETOPS flight. For an ETOPS flight, these procedures should include the shutdown of an engine, fly to and land at the nearest (in terms of the least flying time) aerodrome appropriate for landing.
Factors to be considered when deciding upon the appropriate course of action and suitability of an aerodrome for diversion may include but are not limited to:

a. Aircraft configuration / weight / systems status;

b. Wind and weather conditions en route at the diversion altitude;

c. Minimum altitudes en route to the diversion aerodrome;

i. Fuel required for the diversion;

d. Aerodrome condition, terrain, weather and wind;

e. Runways available and runway surface condition;

f. Approach aids and lighting;

g. RFFS* capability at the diversion aerodrome;

h. Facilities for aircraft occupants - disembarkation & shelter;

i. Medical facilities;

j. Pilot’s familiarity with the aerodrome;

k. Information about the aerodrome available to the flight crew.

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

*Note: for an ETOPS en-route alternate aerodrome, a published RFFS category equivalent to category 4, available at 30 minutes notice, is acceptable.

9. IN-FLIGHT MONITORING

During the flight, the flight crew should remain informed of any significant changes in conditions at designated ETOPS en-route alternate aerodromes. Prior to the ETOPS Entry Point, the forecast weather, established aeroplane status, fuel remaining, field conditions and aerodrome services and facilities at designated ETOPS en-route alternates are to be evaluated. If any conditions are identified which could preclude safe approach and landing on a designated en-route alternate aerodrome, then the flight crew should take appropriate action, such as re-routing as necessary, to remain within the operator's approved diversion time of an en-route alternate aerodrome with forecast weather to be at or above landing minima. In the event this is not possible, the next nearest en-route alternate aerodrome should be selected provided the diversion time does not exceed the maximum approved diversion time. This does not override the pilot in command's authority to select the safest course of action.

10. AEROPLANE PERFORMANCE DATA

The operator should ensure that the Operations Manual contains sufficient data to support the critical fuel reserve and area of operations calculation.

The following data should be based on the Agency approved information (see CS 25.1535) provided or referenced in the Aircraft Flight Manual (AFM).

The requirements for one-engine-inoperative performance en-route can be found in the applicable operational requirements.

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. drift down (includes net performance);
b. cruise altitude coverage including 10,000 feet;
c. holding;
d altitude capability (includes net performance);
e. missed approach.

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.

It should also contain details of any other conditions relevant to extended range operations 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.

The altitudes, airspeeds, thrust settings, and fuel flow used in establishing the ETOPS area of operations for each airframe/engine combination should be used in showing the corresponding terrain and obstruction clearances in accordance with the applicable operational requirements.

11. OPERATIONAL FLIGHT PLAN

The type of operation (i.e. ETOPS) should be listed on the operational flight plan as required by the applicable operational requirements.

APPENDIX 5 - ~~90 MINUTES OR LESS ETOPS OPERATIONAL PROGRAM CRITERIA~~ ETOPS EN-ROUTE ALTERNATE AERODROMES

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

~~1. GENERAL~~

~~Paragraphs 10.a. through 10.i. of this AMC 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 AMC and were not subjected to the operational approval criteria detailed in Paragraph 10, Appendices 3, 4 and 7 of this AMC. 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 AMC. 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 programs.~~

~~(1) Maintenance~~

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

~~(2) Operations~~

~~(i) Operation programs 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 JAA Master Minimum Equipment List (MMEL), including 90 minute or less "Extended Range" provisos.~~

1. SELECTION OF EN-ROUTE ALTERNATE AERODROMES

For an aerodrome to be nominated as an ETOPS en-route alternate for the purpose of this AMC, it should be anticipated that at the expected times of possible use it is an adequate ETOPS aerodrome that meets the weather and field conditions defined in the paragraph below titled 'Dispatch Minima – En-Route Alternate Aerodromes' or the applicable operational requirements.

To list an aerodrome as an ETOPS en-route alternate the following criteria should be met:

a. 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 the applicable operational requirements.
b. The aerodrome services and facilities are adequate to permit an instrument approach procedure to the runway expected to be used while complying with the applicable aerodrome operating minima.
c. The latest available forecast weather conditions for a period commencing at the earliest potential time of landing and ending one hour after the latest nominated time of use of that aerodrome, equals or exceeds the authorised weather minima for en-route alternate aerodromes as provided for by the increments listed in Table 1 of this Appendix. In addition, for the same period, the forecast crosswind component plus any gusts should be within operating limits and within the operators maximum crosswind limitations taking into account the runway condition (dry, wet or contaminated) plus any reduced visibility limits.
d. 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 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.

2. DISPATCH MINIMA – EN-ROUTE ALTERNATE AERODROMES.

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

In addition, for the same period, the forecast wind component, including gusts, should be within limits for the landing runway expected to be used and should not exceed the maximum wind values, as detailed in the Operations Manual for engine inoperative landing taking into account the runway condition (dry, wet or contaminated).

Table 1. Planning Minima

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

The above criteria for precision approaches are only to be applied to Category 1 approaches.
When determining the usability of an Instrument Approach (IAP), forecast wind plus any gusts should be within operating limits, and within the operators maximum crosswind limitations taking into account the runway condition (dry, wet or contaminated) plus any reduced visibility limits.

Conditional forecast elements need not be considered, except that a PROB 40 or TEMPO condition below the lowest applicable operating minima should be taken into account.

When dispatching under the provisions of the MEL, those MEL limitations affecting instrument approach minima should be considered in determining ETOPS alternate minima.

3. EN-ROUTE ALTERNATE AERODROME PLANNING MINIMA – ADVANCED LANDING SYSTEMS

The increments required by Table 1 are normally not applicable to Category II or III minima unless specifically approved by the Authority.

Approval will be based on the following criteria:

a. Aircraft is capable of engine-inoperative Cat II/III landing; and
b. Operator is approved for normal Cat II/III operations.

The Authority may require additional data (such as safety assessment or in-service records) to support such an application. For example, it should be shown that the specific aeroplane type can maintain the capability to safely conduct and complete the Category II/III approach and landing, in accordance with EASA CS-AWO, having encountered failure conditions in the airframe and/or propulsion systems associated with an inoperative engine that would result in the need for a diversion to the route alternate aerodrome.

Systems to support one-engine inoperative Category II or III capability should be serviceable if required to take advantage of Category II or III landing minima at the planning stage.

APPENDIX 6 - ~~NOT USED~~ ETOPS TRAINING PROGRAMME

The operator's ETOPS training programme should provide initial and recurrent training for flight crew as follows:

1 INTRODUCTION TO ETOPS REGULATIONS

a. Brief overview of the history of ETOPS;
b. ETOPS regulations;
c. Definitions;
d. Approved One-Engine-Inoperative Cruise Speed;
e. ETOPS Type Design Approval – a brief synopsis;
f. Maximum approved diversion times;
g. Operator's Approved Diversion Time;
h. Routes and aerodromes intended to be used in the ETOPS area of operations;
i. ETOPS Operations Approval;
j. ETOPS Area and Routes;
k. ETOPS en-route alternates aerodromes including all available let-down aids;
l. Navigation systems accuracy, limitations and operating procedures;
m. Meteorological facilities and availability of information;
n. In-flight monitoring procedures;
o. Computerised Flight Plan;
p. Orientation charts, including low level planning charts and flight progress charts usage (including position plotting);
q. Equal Time Point;
r. Critical fuel.

2 NORMAL OPERATIONS

a. Flight planning and Dispatch
   (1) ETOPS Fuel requirements
   (2) Route Alternate selection - weather minima
   (3) Minimum Equipment List – ETOPS specific
   (4) ETOPS service check and Tech log
   (5) Pre-flight FMS Set up
b. Flight performance progress monitoring
   (1) Flight management, navigation and communication systems.
   (2) Aeroplane system monitoring
   (3) Weather monitoring
   (4) In-flight fuel management – to include independent cross checking of fuel quantity

3 ABNORMAL AND CONTINGENCY PROCEDURES:

a. Diversion Procedures and Diversion 'decision making'.

Initial and recurrent training to prepare flight crews to evaluate potential significant system failures. The goal of this training should be to establish crew competency in dealing with the most probable contingencies. The discussion should include the factors that may require medical, passenger related or non-technical diversions.

b. Navigation and communication systems, including appropriate flight management devices in degraded modes.
c. Fuel Management with degraded systems such as loss of primary FMS.
d. 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 affecting ETOPS sector entry and diversion decisions. If standby sources of electrical power significantly degrade the cockpit instrumentation to the pilots, then training for approaches with the standby generator as the sole power source should be conducted during initial and recurrent training.

    (2) Operational restrictions associated with these system failures including any applicable MEL considerations.

5 ETOPS LINE FLYING UNDER SUPERVISION (LFUS)

During the introduction into service of a new ETOPS type, or conversion of pilots not previously ETOPS qualified where ETOPS approval is sought, a minimum of two ETOPS sectors should be completed including an ETOPS line check.

ETOPS subjects should also be included in annual refresher training as part of the normal process.

6 FLIGHT OPERATIONS STAFF / DISPATCHERS

The operator's training programme in respect to ETOPS should provide training where applicable for operations staff and dispatchers, in addition to refresher training in the following areas:

a. ETOPS Regulations / Operations Approval

b. Aeroplane performance / Diversion procedures

c. Area of Operation

d. Fuel Requirements

e. Dispatch Considerations MEL, CDL, weather minima, and alternate airports

f. Documentation

APPENDIX 7 - ~~REDUCTION OF OPERATOR'S IN-SERVICE EXPERIENCE REQUIREMENT PRIOR TO THE GRANTING OF AN ETOPS OPERATIONAL APPROVAL ('ACCELERATED ETOPS OPERATIONAL APPROVAL')~~ TYPICAL ETOPS OPERATIONS MANUAL SUPPLEMENT

~~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 AMC 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 process 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 AMC 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 AMC, 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 AMC.~~

~~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 Terminology~~

~~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 paragraph~~

~~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 AMC:~~

~~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 AMC.

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 AMC 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.

5. 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.

2. Previous ETOPS experience.

3. Experience with long range, overwater 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.~~

For those operations manuals that are required to have four parts designated A, B, C and D by the applicable operational requirements, the ETOPS section can be divided under these headings as follows:

PART A. GENERAL/BASIC

This part should comprise all non type-related operational policies, instructions and procedures needed for a safe operation.

i. Introduction

(1) Brief description of ETOPS
(2) Definitions

b. Operations approval

(1) Criteria
(2) Assessment
(3) Approved diversion time

c. Qualifications

d. Training and Checking

e. Operating procedures

f. ETOPS operational procedures

g. ETOPS Authorisation

(1) Pilot in command's ultimate responsibility; and pilot in command not to accept illegal ETOPS clearance
(2) Statement to show when ETOPS are allowed

h. ETOPS Flight Preparation and Planning

(1) Aeroplane serviceability
(2) ETOPS Orientation charts
(3) ETOPS alternate selection
(4) En-route alternate weather requirements for Planning
(5) ETOPS computerised Flight Plans

i. Flight Crew Procedures

(1) Dispatch
(2) Re-routing or Diversion decision-making
(3) ETOPS verification (following maintenance) flight requirements
(4) En-route Monitoring

PART B. AEROPLANE OPERATING MATTERS

This part should include type-related instructions and procedures needed for ETOPS.

a. Specific type-related ETOPS operations

(1) ETOPS specific Limitations
(2) Types of ETOPS operations that are approved
(3) Placards and limitations
(4) OEI speed(s)
(5) Identification of ETOPS aeroplanes

b. Dispatch and flight planning, plus in-flight planning

(1) Type-specific flight planning instructions for use during dispatch and post dispatch

(2) Procedures for engine(s)-out operations, ETOPS (particularly the one-engine-inoperative cruise speed and maximum distance to an adequate aerodrome should be included)

c. ETOPS Fuel Planning

d. Critical Fuel Scenario

e. MEL/CDL considerations

f. ETOPS specific Minimum Equipment List items

g. Aeroplane Systems

(1) Aeroplane performance data including speed schedules and power settings

(2) Aeroplane technical differences, special equipment (e.g. satellite communications) and modifications required for ETOPS

PART C. ROUTE AND AERODROME INSTRUCTIONS

This part should comprise all instructions and information needed for the area of operation, to include the following as necessary:

a. ETOPS area and routes, approved area(s) of operations and associated limiting distances
b. ETOPS an-route alternates
c. Meteorological facilities and availability of information for in-flight monitoring
d. Specific ETOPS computerised Flight Plan information
e. Low altitude cruise information, minimum diversion altitude, minimum oxygen requirements and any additional oxygen required on specified routes if MSA restrictions apply
f. Performance and weather minima for aerodromes that are designated as possible alternates

PART D. TRAINING

For those operations manuals that are required to have four parts by the applicable operational requirements, they should have one part prescribing the training for flight crew. This part should contain the route and aerodrome competence and qualification. This competence qualification should have twelve-months of validity or as required by the applicable operational requirements. Flight crew training and qualification for ETOPS should be retained for 3 years or as required by the applicable requirements.

The operator's training programme in respect to ETOPS should include initial and recurrent training/checking as specified in this Appendix.

C. ANNEXES

<u>C.I.</u> REGULATORY IMPACT ASSESSMENT

TWO-ENGINED AEROPLANE WITH A MAXIMUM APPROVED PASSENGER SEATING CONFIGURATION OF 20 OR MORE OR A MAXIMUM TAKEOFF MASS OF MORE THAN 45360 KG USED IN COMMERCIAL AIR TRANSPORTATION AND WITH A MAXIMUM DIVERSION TIME GREATER THAN 60 MINUTES AT THE APPROVED ONE-ENGINE INOPERATIVE SPEED (UNDER STANDARD CONDITIONS IN STILL AIR) FROM AN ADEQUATE AERODROME

1 Purpose and Intended Effect:

a. Issue which the NPA is intended to address:

The increased reliability of the engines and systems of modern two-engined aeroplanes lead to consider the extension of the authorised diversion time beyond the existing 180 minutes threshold prescribed by IL20 (JAA GAI-20 now transferred into EASA AMC 20-6). The prime objective is an adaptation of current ETOPS rule to allow an extension of the diversion time beyond 180 minutes.
In adverse climate areas, the capability for longer diversion times will facilitate the selection of diversion aerodromes that offer a better protection of the passengers after disembarkation.
Ensuring availability of en route alternate airports, fuel planning to account for depressurization, are sound operational practices for all aeroplanes. Industry acknowledges that there are potential routes over the Antarctic that would be as far as 8 hours away from the nearest alternate, or routes over Polar 1-4 where during winter months several en-route alternates may not be available.
JAA/EASA in its Terms of Reference proposed that a consistent set of safety criteria, design and operational, be developed for all commercial long range operations. This would apply to aeroplanes with 2 or more engines. Consistent should be understood as meaning equivalent level of safety and not identical requirements. Even though the JAA/EASA Terms of Reference referred to 'long range operations', the Working Group focussed only on extended diversion time operations since the Working Group did not have the expertise on flight time, duty time, crew composition, human factors related to sleep/crew rest etc. which are typically associated with long range operations.

This NPA proposes regulations and advisory material for extended diversion time operations for two-engined aeroplanes only as explained in the explanatory notes.

b. Scale of the issue (quantified if possible):

The issue is actually multi-disciplinary: Design and manufacture; Operations and maintenance of aircraft are affected.

Aeroplanes used in such operations must have a design approval. Derivative of already approved aeroplanes may be affected by the Changed Product Rule provisions in Part 21. This rule may require upgrade of the type certification basis under certain conditions. However, it should be noted that ETOPS/LROPS approval is not mentioned in the list of examples of significant changes produced to support the Changed Product Rule.

An European manufacturer completed an extensive study that highlighted the challenges of operations in the polar region. The challenges included airport conditions, unavailability of airports, dependability on HF communications at low altitudes, passenger recovery etc. The study stated that that by the year 2010, there would be 39,000 flights per year over Polar 1, 2, 3 & 4 and it could result in as many as 6 flights being diverted in the Arctic every year.

c. Relevant decisions by EAS , JAA or other authorities that guide/constrain action:

ETOPS NPA is included into the EASA rulemaking programme. The ETOPS/LROPS proposals are also included into the JAAT business plan 2007-2008.
These two activities are closely coordinated (EASA has taken over JAAT RM activities from 1st of January 2007). LROPS proposal has been included in EASA inventory for further development.
ICAO Operations panel is also working on the topic of ETOPS/LROPS and this should lead to changes to Annex 6.
The FAA recently issued a new rule on the ETOPS. This new rule affects the following Parts:
Part1, Part-21; Part-25; Part-33, Part-121, Part-135. The proposed changes to the rules are complemented by 5 new stand alone Advisory Circulars. FAA does not establish a distinction between ETOPS and LROPS as done in the JAA/EASA NPAs. A more detailed comparison between FAA and EASA regarding type design can be found in Annex 7 to this RIA.
It should be noted that for quite a while now Transport Canada talks about ETOPS (TP6327) applicable to 2, 3 and 4-engined aeroplanes.
A review of several Authorities web-sites (Australia, Canada, New Zealand, Singapore) has allowed to identify the following regulatory projects related to ETOPS/LROPS:

Canada:

2001-133	TP 6327 Safety Criteria For Approval of Extended Range Twin-Engine Operations (ETOPS)	19 June 2001	File number 20000-001 in legal editing

2001-293	TP 6327 Safety Criteria For Approval of Extended Range Twin-Engine Operations (ETOPS)	18 December 2001	Legal editing

d. Brief statement of the objectives of the NPA – such as a safety improvement:

The following is an excerpt of the terms of reference of the ETOPS/LROPS Ad Hoc Working Group issued to JAA Working Group at the time this activity was started:

"Assess existing design maintenance and operational requirements that may be applicable to Extended Range airframe/engine combinations and assess their applicability to existing and future operations. The group will initially develop broad based recommendations with a view to the production of Requirements and Advisory material for LROPS in respect of both Type Design and Operational Approval, having regard to the needs of both industry and JAA policy."

JAA policy is used here with a broad meaning: it refers to the JAA general objectives.

One of the main reasons for the NPA, based on an European manufacturer study was to address the challenges created by the opening of new polar routes

e. Who and/or what may be affected:

Aircraft and Engine manufacturers; Operators, and Maintenance organisations and European leasing companies are affected.
Authorities are also affected.

f. Options:

(1) The options identified and evaluated:

4 options may be evaluated:

(i) Do nothing:
This means not proposing changes to the present rules. This is the base case.

(ii) Initial NPA package for ETOPS/LROPS as prepared by the group (NPA without RIA):
Changes to the rule have been proposed to JAAT and EASA for JAR-1 and CS-Definitions for definitions, Part 21 for in-service event reporting, CS-25 for airframe approval, CS-E for engine approval and JAR-OPS 1 for operation approval. The majority of the changes have been proposed as advisory material provided against "enabling requirements as detailed below (EASA AMC 20-6).

(iii) To harmonise with the recently existing rules for ETOPS issued by FAA:
The new FAA rule was published by FAA January 2007.

(iv) Revision to the initial NPA package based on initial feedback and concerns expressed by affected parties:
The general idea is to use the development of the RIA to identify points where the burden created by the NPAs could be alleviated without losing sight of their general objectives.

(2) Equity and fairness issues identified:

Competition with non-European operators (worldwide but in particular on routes above Siberia): the concept of severe climate area and of recovery plan is not required under the present NPA. US Operators will have to comply with the passengers recovery plan provisions. The requirements of wind accountability may punish European operators compared to others if foreign Authorities do not adopt comparable requirements.

(3) If possible the preferred option selected:

The group preferred option is the option No.4

(4) Revision to the initial NPA package based on initial feedback and concerns expressed by affected parties

Several suggestions were made:
(i) Allow for an increase in threshold time for ETOPS. The proposed figure is 15%;
(ii) Recovery Plans – Passengers recovery plan for severe climate area to be considered in a separate A-NPA;
(iii) Revise NPA proposal to delete the concept of severe climate areas and align with FAA rules;

(iv) Regarding wind accountability beyond 180 min, consider using the words as proposed in FAA rules;

(v) Reformat the document: to ease harmonisation in case common formatting with the FAA new rules is maintained.

The above list represents all the suggestions that were made during the JAA OST 05-3 in September 2005. Additional suggestions were made during the presentation at the JAA OST 06-5. The present proposal has considered the main suggestion made.

g. Impacts:

(1) Sectors Affected:

(i) (S) TC holder s: 5 (Airbus, Boeing, Bombardier, ATR, and Embraer);

(ii) Engine manufacturers: 6 (Pratt, GE, RR, CFM, IAE and Pratt Canada);

(iii) Operators: around 50 (Manufacturer B records show 22 European ETOPS operators out of a total of 101 worldwide);

(iv) Maintenance Organisations: 20 (Base maintenance) but all maintenance organisations at ETOPS airport are affected;

(v) Design Organisations: 10 (Because they could affect the ETOPS capability (e.g. cargo modifiers (Old A-310, 767, etc.));

(vi) Leasing companies: 3 (They are the leasing companies that have European registered Airbus ETOPS aircraft operated by non-European operators)

(2) Safety Impact:

(i) Data gathered from present experience:

1) Airbus experience:

Airbus does not have complete visibility of the world data concerning the safe completion of diversions to difficult airports. Only the events occurred on Airbus aircraft and those that have resulted in accidents and/or high-risk situations for occupants are available.

- *Diversion for medical reason:*

0.5 to 1.3 medical diversions per 1000 long-range flights.
Only 1.5 % of medical diversions effectively require rapid medical attention.
Medical events remain generally compatible with completion of the flight except a few ones that require urgent medical attention. These rare events are not compatible with the duration of a diversion and may only be addresses onboard.
10% of medical diversions conducted during cruise phase require a subsequent medical evacuation as they use airports without adequate medical facilities.
This information can be complemented by data found in several Flight Safety Foundation publications:

➢ One of about million passengers suffered a medical emergency serious enough to require an unscheduled landing of the aircraft (Cabin Crew Safety March-April 1997 page 1).

➢ 8.85 of the flights, in which there was a medical emergency, were diverted annually (Cabin Crew Safety March-April 1997 page 1).

➢ Out of the 1132 in-flight medical incidents, 145 (13%) resulted in an emergency diversions (Cabin Crew Safety March-April 2000 page 6).

➢ Diversions from a technical cause during the cruise phase (ETOPS sector): 1.8 per 100,000 ETOPS flights.
➢ Diversions caused or aggravated by factors not addressed by current ETOPS design criteria in EASA AMC 20-6.
Airbus aircraft experienced 4 ETOPS diversions that were caused or aggravated by lack of sufficient fuel onboard and lack of crew awareness of the fuel situation.
➢ Other situations potentially affecting safety of ETOPS diversions and not addressed by current ETOPS design criteria in EASA AMC 20-6: none on Airbus aircraft.

Airbus experience on ETOPS products can also be presented product per product:

- **A300-600 ETOPS events: 1989-2002:**

ETOPS take-offs: 51,000 Total events: 35
Cruise events: 0

- **A319/A320/A321 ETOPS events: 1993-2002:**

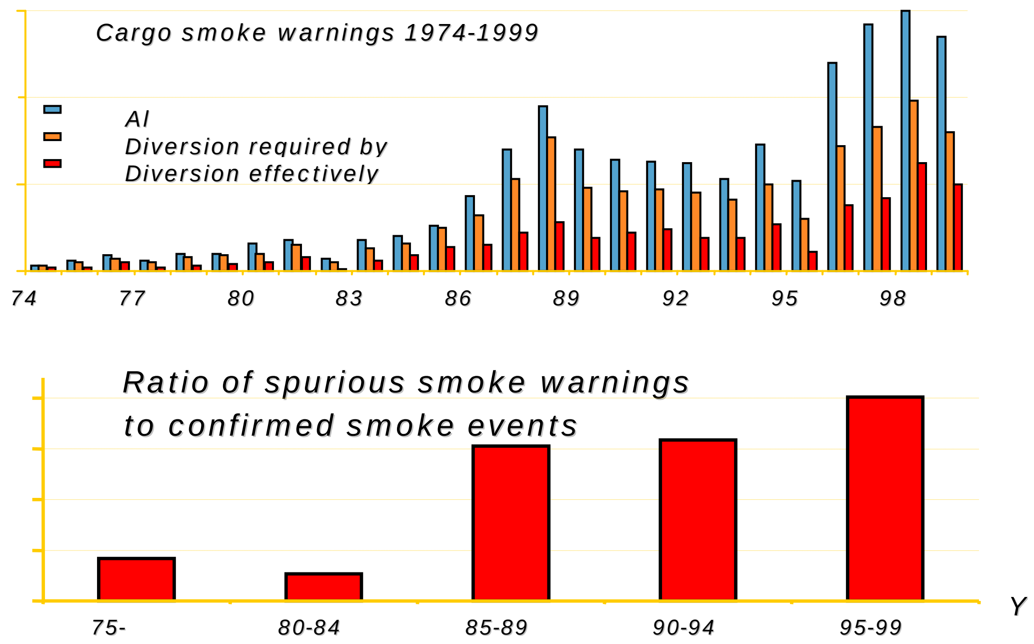
ETOPS take-offs: 21,000 Total events: 5
Cruise events: 0

- **A330 ETOPS events: 1994-2002**

ETOPS take-offs: 210,000 Total events: 79
Cruise events: 5

Airbus provided also data on cargo-smoke events:

Cargo-Smoke events - Service experience



SAFETY IMPACT AND RELEVANCE OF NPA MATERIAL

- Unnecessary diversion with possible use of a higher risk airport (Ratio 200 to 1);
- 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;
- Flight continued beyond usable, safe diversion airport exceeding the certified cargo fire protection time (40%): No relevant provision in current NPA;
- Flight continued while fire was effectively present:4 known cases including 1 event on Airbus aircraft.

2) Boeing experience:

Boeing data shows air turn back and diversion rates for twins and quads are comparable (e.g., for 2003, 20.2 (for B777) versus 26.0 (for B747-400) per 100,000 departures).
Boeing does not have complete data to report a medical diversion rate; however, based on limited data Boeing has, it appears over 90% of the diversions are for non-technical reasons which include medical.
The diversion rate for technical causes in B777 is 8.2 per 100,000 flights as an example.

3) AEA experience:

AEA conducted a survey of its members and the results are presented in Annex 1 to this RIA. (Note that AEA provided data for the initial NPA package that included provisions for LROPS. The initial data provided has been kept for consistence although it has to be highlight that this NPA does not address LROPS concept).

4) Synthesis of present experience:

The data provided by the affected industry was not presented in a systematic way. That is why no clear synthesis or conclusion could be developed.
However, a synthesis was possible on technical causes because both Airbus and the AEA survey address that point:
The AEA survey indicates a diversion rate of 1.2 x 10-4 per flight due to technical causes for both ETOPS and non-ETOPS flight.
Airbus has quoted a diversion rate of 1.8 per 100 000 flight due to technical causes in the ETOPS sector.

(ii) Forecasting diversion risk:

The evaluation of diversion risk (including the possibility of diverting to an airport in severe climate area where no shelter or recovery plan is available) needs to obtain traffic forecast. Airbus and Boeing have provided such forecasts (See Annex 2).
The forecast are not easy to compare because they are expressed differently:
Airbus expresses the forecast by frequency and identifies the capacity of the aeroplane.
Boeing expresses the forecast in RPK and does not identify the capacity of the aeroplane.

Taking the example of the traffic between Europe and Northeast Asia, Boeing envisages that the traffic will by multiplied by 3.4 and Airbus by 1.8 (for aeroplanes with a capacity of 250 passengers) between 2002 and 2022.

This could mean that the number of diversion in Siberia could be between 1 and 2 per year for AEA Operators in 2022.

During the period 2002-2022 a total of 14 to 21 diversions in Siberia alone could be estimated.
In order to try and evaluate the probability of one of these diversions ending up into an accident, a review was made of all accidents to large transport aeroplane involving a diversion using the Air Claims World Airlines Accident Summary (1990-2003).
69 such accidents were found out of which 13 resulted in fatalities. The table in Annex 6 provides further information on such accidents.
These accidents are not directly related to an ETOPS en-route diversion scenario. Therefore direct use of the results in this context is to be taken with precautions. An ETOPS diversion is without doubt an event for which the flight crew has been well prepared. Therefore the likelihood to see one diversion out of 5 ending up with fatalities is too high.
As described by IFALPA in their comments, the cost of one accident of an aeroplane carrying 400 passengers can be estimated to $ 1.5 billions using US Government Accounting Office data.

(3) Economic Impact:

The economic impact is organised in 3 main elements: design costs, operations costs and maintenance costs.
Annex 3 to this RIA was used as a starting basis to identify economic impact. Only the most significant ones are discussed in this paragraph.

(i) Design costs:

1) Manufacture A evaluation:
Manufacturers of ETOPS aircraft will have to comply with the new design requirements if:

- The product has not yet been certified for ETOPS in Europe;
- The product is a new Type;
- The product is a derivative found to present Significant Changes according to the Change Product Rule (CPR) criteria (For more information see CPR: EASA Part 21 A.101 and associated Acceptable Means of Compliance);
- The product is presented for ETOPS with more than 180-minute diversion time.

The extra cost to certify to the new criteria originates from the design requirements that did not exist before amending EASA AMC 20-6:

- Assessment of all time-limited systems in normal and degraded system configurations in the order of M$ 0.5 per aircraft family. Any design change found necessary as a result of this assessment would increase this cost. No impact on Manufacturer A aircraft as they are already compliant.
- Full numerical system safety assessment of all aircraft systems, using the maximum duration of an ETOPS mission and maximum diversion time for Group 1 systems, for all its ETOPS aircraft in the order of M$ 1 per aircraft family. Any design change found necessary as a result of this assessment would increase this cost. No impact on its aircraft as they are already compliant.
- Flight test demonstration of the handling quality with ice shapes on unprotected airframe surfaces beyond the thickness required for compliance with Section 25.1419 and Part 25 Appendix C, up to the most critical thickness that may be encountered during an ETOPS diversion at 10,000 ft, in the order of M$ 1.5 per aircraft family. Any design change found necessary as a result of this assessment would increase this cost. The flight test is a very high-risk test because of the need

to takeoff with the simulated ice shapes on the wing. Aircraft with airfoil that present more sensitivity to ice build-up may not pass the test.

- Fuel alerts for all system malfunctions and operational errors in the order of M$ 2.5 per aircraft family. The cost of a full installation will be $ 200,000 per aircraft; the cost of a partial installation will be up to $ 110,000 per aircraft.
- Installation of new of cargo fire protection system on aircraft with only 15 minute margin versus diversion time in still air ISA conditions. No cost for Manufacturer A aircraft as they all have sufficient margin to cover the wind and temperature effect. Retrofit cost may have to be considered for operators of other makes of ETOPS aircraft.

2) Manufacturer B evaluation:

Manufacturer B does not consider most of the items above to be new cost items. Manufacturer B has always assessed the aeroplane for the ETOPS mission. No significant impact on current approvals up to 180 minutes (provided the errors in the NPA on wind accountability, discussed earlier, are corrected) was estimated. If Manufacturer B wants to increase the diversion capability of the twins beyond 180 minutes, and provide additional flexibility, they believe they will have to address the new requirements that ensure the ETOPS missions are safe.

ETOPS certification will allow a twin to fly on a route where a tri/quad could fly. So, the benefit of ETOPS certification is that it will allow an airline to operate a twin of comparable size as a tri or quad. In the process it will benefit the airline: $17.26 million per year for a fleet of 15 aeroplanes. If a manufacturer is able to sell at least about 500 ETOPS approved aeroplane of the type, combined benefit to the operators is around $575 million per year.

As these two evaluations are significantly different both have been presented. Comments from other manufacturers are welcome here to complement the two above evaluation.

(i) Operational costs:

1) Cost related with the changes in the Operational approval:

- Manufacturer A evaluation:
  The lead-time for the companies that supply computerized flight-plan and map plotting systems to release new versions of their applications compliant with the new rules is 12 months after the date when the rule is frozen and known to the public in final form. These companies may not be requested to work at own risks on a draft rule that may be modified. The cost of the updating the necessary software applications can be estimated to between $ 7,000 to $ 15,000 depending on the application and supplier. The above numbers provided by Manufacturer A are rock-bottom cost assuming no customisation and FAA/JA-EASA identical requirements.

  The overall cost of documentary modifications and re-issuing of documents and manuals is estimated to $ 200,000 for an operator with one ETOPS aircraft type only. The lead-time is in the order of six months.

  The cost of retraining dispatchers and flight crews to the new fuel reserves and dispatch criteria is estimated to $ 150,000 for a fleet of six ETOPS aircraft of one type. The lead-time is three months after the new software applications have been deployed and validated. (Manufacturer A data).

Fuel reserve makes some changes to allowances, and dispatch criteria changes are minimal. Inputs received from some of our operators: if the training is done for 300 people for 30 minutes at $100 per hour rate, the total cost of retraining will be $15,000. (Manufacturer B data).

The costs related with changes in the Operational Approval can be alleviated by providing an appropriate lead time to comply with the new proposals. 12 months could be an adequate period.

- Manufacturer B evaluation:

There should be no significant change in the operations up to 180 minutes. Airlines should be able to accommodate the small adjustments in the fuel planning, weather minima without incurring significant additional cost. Operations beyond 180 minutes for twins will be a new authority for most of the European operators.

- Rescue and Fire-fighting Services (RFFS) requirements:

The impact of the RFFS level 7 was estimated:
The Association of European Airlines using a study performed by Boeing estimated that the probability of an In Flight Shut Down during the ETOPS portion in cruise, diversion to an ETOPS en-route alternate and a brake fire during landing that would require the use of Fire-fighting Services would fall approximately between:
1.6 x 10-10 and 3.2 x 10-9 per flight. (assuming a 10 hour flight).

The equipment for RFF category 4 and 7 are the following:
-Category 4 requires of 3600 litres of water and 135 kg of dry chemical powder with a minimum of one (1) vehicle. Water discharge is 2600 litres per minute.
-Category 7 requires 18200 litres of water and 225 kg of dry chemical powder and a minimum of two (2) vehicles. Water discharge is 7900 litres per minute.
Categorisation is based on the longest aeroplane normally using the aerodrome and their fuselage width. However when the number of movement of the highest category normally using the aerodrome is less than 700 in the busiest consecutive three month, the level shall be not less than one category below the determined category.
Category 4 corresponds to aeroplane with an overall length between 18 and 24 meters and a fuselage width of maximum 4 meters. (E.g. ATR 42, Fokker 27).
Category 7 corresponds to aeroplane with an overall length between 39 and 49 meters and a fuselage width of maximum 5 meters. (E.g. A-310, Boeing 757, MD-80).
To achieve this higher amount of water a large truck would be required and it is more likely that 2 additional trucks will be required on top of category 4.
The number of personnel to equip the truck(s) will be at least an additional 6, but practically it will be more.
A truck costs somewhere around 500.000 euro but this may vary.
Requiring RFFS level 7 will put pressure on Airport to upgrade their RFFS level for that reason only (their normal traffic may not require such level) and they will in turn charge operators.
Attachment 6 provides a survey of aerodrome in the severe climate area with in particular their RFFS level (this is a preliminary survey).
A proposal to alleviate the impact of RFFS level 7 may be made along the following lines:

Where there is a temporary aerodrome closure or reduction in RFF capability, operations may continue subject to meeting the requirements of ICAO Annex 14 level 4. Any use of this alleviation should be reported to the Authority.

2) Operational penalty on non-ETOPS routes:

The new definition of Adequate Aerodrome for Severe Climate Areas implies verification that the airports are open at the time of possible use. This may force operators to apply for a precautionary ETOPS approval on routes where the closure of one airport would increase the diversion time beyond 60 minutes.

The full cost of such ETOPS approval cannot be estimated precisely. It includes all operational, maintenance, training and documentary cost of an ETOPS approval, plus any cost to certify and modify the aircraft to ETOPS standards. The cost is considered to be generally high enough to be unacceptable. As a result the operator will face a variable percentage of cancelled flights:

- North Atlantic return flights under MEL: 15% of cancelled flight;
- East Africa-Europe flights 10% of cancelled flights;
- This penalty might be alleviated by introducing a flexibility to dispatch case-by-case 15% beyond the rule threshold time.

Based on information received from Manufacturer B operators, the cost of obtaining an ETOPS approval seems to be negligible for some operators. On average it seems to be around $120,000 per airline.

3) Savings due to reduction of the cost of ETOPS fuel reserves and to new weather minima:

- Manufacturer A evaluation:
  The new criteria will reduce the ETOPS critical fuel scenario with icing by up to 50%. ETOPS fuel reserves will no longer exceed the normal route reserves for diversion time up to 180 minutes irrespective of the position of the ETOPS sector along the route, unless the operator has a fuel reserve policy based on significantly less than 5% of the trip fuel.

- Manufacturer B evaluation:
  Even though the current critical fuel scenario is still slightly more penalising than the fuel required for diversion as per JAR OPS 1.255. Manufacturer B was pleased that JAA has taken a step in the right direction. Manufacturer B fully supported the critical fuel scenario proposed in the ETOPS/LROPS Package provided by ETOPS/LROPS Ad Hoc Working Group. Some operators have informed Manufacturer B that the change in fuel could result in 5000lbs payload increase in some routes. Depending on the sector the revenue from this payload will vary. It probably is safe to say that European operators probably generate upwards of $1 million in additional revenue. Less quantity of fuel results in slightly lower fuel consumption resulting in additional environmental benefits.
  Manufacturer B also supports the alternate weather minima proposed by the NPA.
  The revised weather minima will result in less disruption in flight dispatch, and also allow airlines to use optimum routing. This could save current European operators anywhere upwards of $1 million.

(ii) Maintenance costs:

For operators already approved for 180 minutes diversion time the additional costs related to the extension of the diversion time beyond this limit are considered minor.

(iii) Authorities and EASA costs:

Authorities and EASA are familiar with the ETOPS concept. There may be changes to existing approvals due to the possibility to go beyond 180 minutes.

(4) Environmental Impact:

No significant impact was identified.

(5) Social Impact:

A comment emphasised the legal threat on operators in case a diversion resulting in passengers' discomfort or other inconveniences. This comment proposed to adopt a system of a universal recovery plan for all ETOPS en-route alternate airports including a guarantee of maximum time until the journey is normally resumed will be addressed in a separated A-NPA. This clearly adds a social dimension to the issue that was not initially contemplated. The Authorities believe that the legal and social impact of diversions is not a mater of airworthiness and operational regulations provided the rules adequately address all aspects of occupants' safety.

The social impact related to longer flights (Flight and Duty time issues) is not addressed by this NPA.

(6) Impact on other aviation requirements outside the EASA scope, such as security, ATM, airports, etc.

As already explained above to be consistent with the existing EASA AMC 20-6 material, the operational considerations have been amended even if Air Operations are not yet under the scope of EASA regulation. As already explained the extension of the scope of the Basic Regulation to the field of air operations and flight crew licensing is expected to be adopted by the European Parliament and the European Council in the very near future.
No other impact in this field could be evaluated.

h. Consultation:

The following bodies were consulted during preparation of the RIA prior to the issue of the NPA:

- ETOPS/LROPS Working Group;
- JAA Operational Sectorial Team and experts sub-groups: in addition to debate in OST, written input received from IFALPA (See Annex 5);
- EASA.

The Operations Sectorial Team was consulted in September 2005 and last November 2006.

i. Summary and Final Assessment:

(1) Comparison of the positive and negative impacts for each option evaluated:

- Do nothing: Safety: possibility of diversion to inadequate aerodromes. Economic impact: prevent operations beyond 180 minutes. Not in line with ICAO proposals. Not harmonised with FAA new rule.
- The previous package: Some provisions were highly criticised by Operators.
- FAA new rule: Harmonisation with the FAA has been considered as part of the Terms of Reference.
- Revision to the JAA/EASA NPAs based on initial feedback and concerns expressed by affected parties: preferred option as it alleviates the main concerns expressed by Operators.

(2) Summary of who would be affected by these impacts and issues of equity and fairness:

Aircraft and Engine manufacturers; Operators, and Maintenance organisations and European leasing companies are affected.
Authorities are also affected.

(3) Final assessment and recommendation of a preferred option:

Revision to the JAA/EASA NPA based on initial feedback and concerns expressed by affected parties.

<u>C.II.</u> REGULATORY IMPACT ASSESSMENT

TWO–ENGINED AEROPLANES WITH A MAXIMUM APPROVED PASSENGER SEATING CONFIGURATION OF 19 OR LESS AND A MAXIMUM TAKE-OFF MASS LESS THAN 45360 KG USED IN COMMERCIAL AIR TRANSPORTATION AND WITH A MAXIMUM DIVERSION TIME GREATER THAN 180 MINUTES AT THE APPROVED ONE-ENGINE OPERATIVE SPEED (UNDER STANDARD CONDITIONS IN STILL AIR) FROM AN ADEQUATE AERODROME.

1 Purpose and Intended Effect:

a. Issue which the NPA is intended to address:

Present rule limits to 180 minutes the diversion times authorised for the operations of two-engined aeroplanes with a seating capacity of 19 seats or less. The reliability of the engines and systems of modern two-engined aeroplanes lead to consider the extension of the authorised diversion time beyond the existing 180 minutes threshold prescribed by the applicable operational requirements and EASA AMC 20-6.

The reliability and system architecture of modern twin engine aeroplanes, and operational practices developed specifically to address the Acceptable Means of Compliance of EASA AMC 20-6 have led the industry to recognise that all aeroplanes on extended diversion time operations, regardless of the number of engines, need a viable diversion airport in case of adverse aircraft related events that could preclude the continued safe flight and landing. Boeing data shows air turn back & diversion rates for twins and quads are comparable (e.g., for 2003, 202 (for B777) versus 260 (for B747-400) per million departures). Ensuring availability of en route alternate airports, fuel planning to account for depressurisation, are sound operational practices for all aeroplanes. Industry acknowledges that there are potential routes over the Antarctic that would be as far as 8 hours away from the nearest alternate, or routes over Polar 1-4 where during winter months several en-route alternates may not be available. JAA/EASA ETOPS/LROPS Ad Hoc Working Group in its Terms of Reference proposed that a consistent set of safety criteria, design and operational, be developed for all commercial long range operations. This would apply to aeroplanes with two or more engines. Consistent should be understood as meaning equivalent level of safety and not identical requirements. Even though the Terms of Reference referred to ‘long range operations’, the Working Group focussed only on extended diversion time operations since it did not have the expertise on flight time, duty time, crew composition, human factors related to sleep/crew rest etc. which are typically associated with long range operations.

b. Scale of the issue (quantified if possible):

The issue is actually multi-disciplinary: Design and manufacture; Operations and maintenance of aircraft are affected.

Aeroplanes used in such operations must have a design approval. Derivative of already approved aeroplanes may be affected by the Changed Product Rule in Part 21. This rule may require upgrade of the type certification basis under certain conditions. However it should be noted that ETOPS approval is not mentioned in the list of examples of significant changes produced to support the Changed Product Rule.

c. Relevant decisions by EASA, JAA or other authorities that guide/constrain action:

ETOPS NPA is included into the EASA rulemaking programme. The ETOPS/LROPS proposals are also included into JAAT business plan 2007-2008.
These two activities are closely coordinated (EASA has taken over JAAT RM activities from 1st of January 2007). LROPS proposal has been included in EASA inventory for further development.
ICAO Operations panel is also working on the topic of ETOPS/LROPS and this should lead to changes to Annex 6.
The FAA recently issued a new rule on the ETOPS. This new rule affects the following Parts:
Part-1, Part-21; Part-25; Part-33, Part-121, Part-135. The proposed changes of the rule are complemented by 5 new stand alone Advisory Circulars. FAA does not establish a distinction between ETOPS and LROPS as done in the JAA/EASA NPAs. A more detailed comparison between FAA and EASA regarding type design can be found in Annex 7 to this RIA.
It should be noted that for quite a while now Transport Canada talks about ETOPS (TP6327) applicable to 2, 3 and 4-engined aeroplanes.
A review of several Authorities web-sites (Australia, Canada, New-Zealand, Singapore) has allowed to identify the following regulatory projects related to ETOPS/LROPS:

Canada:

2001-133	TP 6327 Safety Criteria For Approval of Extended Range Twin-Engine Operations (ETOPS)	19 June 2001	File number 20000-001 in legal editing

2001-293	TP 6327 Safety Criteria For Approval of Extended Range Twin-Engine Operations (ETOPS)	18 December 2001	Legal editing

d. Who and/or what may be affected:

Aircraft and Engine manufacturers (potentially); Operators, and Maintenance organisations and European leasing companies are affected.
Authorities are also affected.

e. Options:

The same options identified in Annex 1 to this RIA may be evaluated:

f. Equity and fairness issues identified:

(1) If possible the preferred option selected:

Revision to the JAA/EASA NPAs based on initial feedback and concerns expressed by affected parties

Several suggestions were made:

- Allow for an increase in threshold time for both ETOPS. The proposed figure is 15%.

- Severe Climate Areas and Passengers Recovery plans to be dealt in a separated A-NPA.

- Regarding wind accountability beyond 180 minutes, consider using the words as included in FAA rules.

- Reformat the document: to help the harmonisation in case common formatting with the FAA is maintained.

g. Impacts:

(1) Sectors Affected:

With regards to two–engined operations there is presently no operator identified approved to operate beyond 120 minutes. The conditions to obtain an approval for diversion times between 120 minutes and 180 minutes have not been changed.
However in order to avoid un-intended effects and to be consistent with Annex 1 to this RIA, the same extension of 15% of the threshold will be offered.
In the future the market may be triggered by the development of longer range aeroplanes for which the NPA would apply.
Further general information can be found in Annex 5.

(2) Safety Impact:

A positive safety impact is estimated since these operations will be regulated by and oversight by NAAs.

(3) Economic impact:

No impact is identified on existing European operations.

(4) Environmental Impact:

No significant impact was identified.

(5) Social Impact:

A comment emphasised the legal threat on operators in case a diversion resulting in passengers' discomfort or other inconveniences. This comment proposed to adopt a system of a universal recovery plan for all ETOPS en-route alternate airports including a guarantee of maximum time until the journey is normally resumed will be addressed in a separated A-NPA. This clearly adds a social dimension to the issue that was not initially contemplated. The Authorities believe that the legal and social impact of diversions is not a mater of airworthiness and operational regulations provided the rules adequately address all aspects of occupants' safety.

The social impact related to longer flights (Flight and Duty time issues) is not addressed by this NPA.

(6) Impact on other aviation requirements outside the JAA scope, such as security, ATM, airports, etc.

As already explained above to be consistent with the existing EASA AMC 20-6 material, the operational considerations have been amended even if Air Operations are not yet under the scope of EASA regulation. As already explained the extension of the scope of the Basic Regulation to the field of air operations and flight crew licensing is expected to be adopted by the European Parliament and the European Council in very near future.
No other impact in this field could be evaluated.

h. Consultation:

The following bodies were consulted during preparation of the RIA prior to the issue of the NPA:

- ETOPS/LROPS Working Group;
- JAA Operational Sectorial Team and experts sub-groups: in addition to debate in OST, written input received from IFALPA (See Annex 5);
- EASA.

The Operations Sectorial Team was consulted in September 2005 and last November 2006.

i. Summary and Final Assessment:

(1) Comparison of the positive and negative impacts for each option evaluated

- <u>Do nothing</u>: Safety: possibility of diversion to inadequate aerodromes. Economic impact: prevent operations beyond 180 minutes. Not in line with ICAO proposals. No harmonized with FAA new rule;
- <u>The previous package</u>: Some provisions were highly criticised by Operators;
- <u>FAA new rule</u>: harmonization with the FAA has been considered as part of the Terms of Reference;
- <u>Revision to the JAA/EASA NPAs based on initial feedback and concerns expressed by affected parties:</u> preferred option as it alleviates the main concerns expressed by Operators.

(2) Summary of who would be affected by these impacts and issues of equity and fairness:

Aircraft and Engine manufacturers; Operators, and Maintenance organisations and European leasing companies are affected.
Authorities are also affected.

(3) Final assessment and recommendation of a preferred option:

Revision to the JAA/EASA NPA based on initial feedback and concerns expressed by affected parties.

<u>Annex 1 to RIA</u>

AEA Survey on diversions to alternate airports
(2nd June 2004)

Background:
In response to the AEA concerns on the planned JAA/EASA Long Range Operations (LROPS) rulemaking activity on three and four engined aircraft (e.g. imposing ETOPS type of requirements on such aircraft when operated at more than 180 min from an adequate aerodrome), the JAA - in coordination with EASA, is working on a Regulatory Impact Assessment. As part of this exercise, AEA has been asked to provide some more background info on the number of diversions during the last years (in particular over Siberia) and whether any particular problems where encountered when landing at those alternate airports.

Questions Asked:
During the last five years (if only an estimate is available - pls indicate) (note: this questionnaire is applicable for ETOPS flights and 3/4 engine aircraft flights):

1) How many diversion due to technical (engine) problems did you experience during the ETOPS portion of a flight (e.g. diversion while on ETOPS segment to ETOPS alternate) of a twin engine aircraft (compared to total nr of flights)? If yes and if possible you specify which alternate airports which where used and whether you experienced any problems?

2) How many diversions of three and four engined aircraft did you have (compared to total nr of flights)?

Of these diversions how many where a) technical b) medical c) other reason + please specify alternate airports used (and whether there were any problems)

3) Same question as 2) but for twin engined aircraft diversions which are not ETOPS/engine related?

4) Did you ever use (divert to) alternate airports in Siberia and if yes please specify which airports were used and whether you encountered any particular problems when landing at those airports?

Replies to AEA Survey:

Airline A:

1. 3 diversions on an ETOPS segment due to technical reasons. Airports used: Gander, Khartoum and Kilimanjaro. 10000 ETOPS flights per year

2. 635 diversions (on 500000 flights) during the last 5 years. For 3 and 4 engined aircraft: 46 (technical) (total 105 technical including ETOPS and non-ETOPS), 74 (medical) and the rest weather or miscellaneous

3. For two engined aircraft: 56 (technical)

4. No diversions in Siberia

Count of DIVCODE YEAR

DIVCODE	1999	2000	2001	2002	2003	2004	Grand Total	
ATC		4	4	6	3	2	1	20
BST		2	4		1			7
CLS		3	7	20	3	4		37
DEV					18	26	2	46
ILL		14	18	14	17	12		75
MSC		7	9	6	3	7		32
QLF		1	1	1				3
RCL				1				1
TEC		34	36	24	12			106
WXF		14	17	27	46	52	2	158
WXR		25	40	32	8			105
WXS				1	1	1		3
WXX					18	19	2	39

Grand Total 104 136 132 130 123 7 632

DEV en TEC are technical diversions, ILL are medical diversions and WXX, WXR, WXS and WXF are weather related, There have been three ETOPS related diversions (2001-1x, 02-1x, 03-1x)

Airline B:

1) Airline B: 1 occurrence for a total of 76 871 flights (ETOPS and non ETOPS flights)

Alternate Airport used: Fortaleza (Brazil). Only commercial problems were experienced e.g. dispatch of pax in hotels was not well prepared, rooms were not booked early enough causing confusion. NO SAFETY problems recorded.

2) How many diversions of three and four engined aircraft did you have (compared to total nr of flights)? total nb of flights (744+340 aeroplanes) : 20 of 99 412 (approx. 0.2 / 1000 flights) (13 technical, 5 medical, 2 unruly pax)

Alternate airports used: ABJ, BSB, DXB, HAM, LAJ, LAX, LHR, LIL, LOS, LYS, LBV, MRS, ORY, TLS (2), VIE, YHZ(3), YMX: no safety related problems recorded.

3) Same question as 2) but for twin engined aircraft diversions which are not ETOPS/engine related? 12 diversions for a total of 76 871 flights (ETOPS and non ETOPS flights) (approx. 0.156 / 1000 flights) (5 technical, 4 medical, 1 unruly pax and 2 ops reasons).

Alternate airports used: BKO, DKR, PEK(2), PIK, SVO, THR, VLC, YMX, YYQ,
YYZ(2).

4) Did you ever use (divert to) alternate airports in Siberia and if yes please specify which airports were used and whether you encountered any particular problems when landing at those airports? No (except if SVO & PEK are considered as part of Siberia. If so, no problems recorded when landing).

Airline C:

In airline C a diversion in itself is not a reason for a pilot to file a report. Nevertheless I have gone through the Safety Reports for all 767, A340 and A330 flights since 1999 to now (i.e. 24 May 2004) to be able to reply on the survey on diversions. Bearing the above in mind it should be noted that not all diversions are documented e.g. the September 9th event resulted in several diversions for us but no one was documented in a pilot report. Anyway, please find below our reply to the survey. Don't hesitate to let me know if there is anything that requires an explanation.

1) Nbr of diversions due engine problems during ETOPS: 1 to YYZ, 1 to KEF
   Total nbr of flights: 28222

2) Nbr of diversions due technical problems: 0
   Nbr of diversions due medical: 0
   Nbr of diversions due other reasons: 1 to EWR
   Total nbr of flights: 10964

3) Nbr of diversions due tech (not ETOPS/engine): 1 to BGO
   Nbr of diversions due sick/unruly passengers: 6
   Nbr of diversions due other reasons: 4
   Total nbr of flights: 28222

4) In the beginning of our operations with 767 we diverted to Surgut and Syktyvkar. The only thing I remember was that one of the pilots said that ATC communication was ok as long as it was standard phrases but became difficult when non-standard. More details could be retrieved if necessary.

Airline D:

1) NONE, Total 21384 A330 Flights
NIL engine shut-downs
NIL diversion within ETOPS range

2) Total 2992 A340 flights
NIL Engine shut-downs
1 diversion to CYYR due unruly Pax

We don NOT track diversions which are not technical related and which do not pose problems. e.g. Diversions to the planned Destination Alternate due to bad WX at Dest...

3) Same question as 2) but for twin engined aircraft diversions which are not ETOPS/engine related? Sorry, data missing

4) Did you ever use (divert to) alternate airports in Siberia? NO

Airline E:
(comment: exact data not for full five years e.g. from 01JAN2000-06MAY2004)
1) Airline E: total no. of ETOPS flights: 2705
total no. of diversions due to engine problems on ETOPS segment: none

2) Airline E:total no. of flights with 4-engine a/c: 177057
total no. of diversions with 4-engine a/c: 425
total no. of en-route diversions with 4-engine a/c: 153 (included in total figure of 425)

Of these diversions how many where a) technical b) medical c) other reason + please specify alternate airports used (and whether there were any problems)
Airline E: for en-route diversions only (note: all other 272 diversions were to either destination alternate, departure alternate, or return to departure airport, exact analysis of these reasons not done now, as not ETOPS/LROPS-relevant):
a) technical: 16
b) medical: 99
c) other: 38
statistics about en-route alternate airports to be found in attachment

3) Same question as 2) but for twin engined aircraft diversions which are not ETOPS/engine related?
Airline E:
(note: no analysis of huge data amount for cont flights, which is also mostly 2-engine ops, but definitively not ETOPS-relevant)
total no. of intercont flights with 2-engine a/c: 13215 non-ETOPS plus 2705 ETOPS
total no. of diversions with 2-engine a/c: 24 non-ETOPS plus 10 ETOPS
total no. of en-route diversions with 2-engine a/c: 1 non-ETOPS plus 4 ETOPS (included in total figure of 24+10)

for en-route alternates only (note: all other 23+6 diversions were to either destination alternate, departure alternate, or return to departure airport, exact analysis of these reasons not done now):
a) technical: 1
b) medical: 3 (of which 1 may have occurred on ETOPS segment, but exact time not known)
c) other: 1 (this 1 was due to an unruly pax, and may have occurred on ETOPS segment, but exact time not known)
statistics about en-route alternate airports to be found in attachment

4) Did you ever use (divert to) alternate airports in Siberia and if yes please specify which airports were used and whether you encountered any particular problems when landing at those airports?
Airline E:
2 diversions to SVX/RU Ekaterinburg, no problems, airport is scheduled Airline E destination
1 diversion to OVB/RU Novosibirsk, no problems, though currently not any longer Airline E destination
no landing at other Siberian airports or airfields.

Airline F:

The numbers relate to 5 years as requested.

The data Source is Air Safety reporting by crew; a diversion requires a report so the coverage should be good. I have only shown diversions where the crew quoted the flight phase as 'Cruise'. This includes a number of flights where the decision to divert for a Terminal Weather problem is said to have been taken in cruise, though some of these may have been misreported. For the year 2003, separate Engineering summaries were available and about 90% of reports feature in both lists; errors are likely to be due to miscoding of flight phase.. the tab labelled 'all diversions' contains some duplicates which I have deleted in the final count

Between 99 and 04, the vast majority of our ETOPS sectors were flown by B777. I include the B767 data in the spreadsheet, but for the moment I do not have B767 ETOPS sector counts, but the numbers are relatively small and will not affect any conclusions. The B767 made no diversions to Siberia, not least because the majority of the ETOPS flights it operates are to Africa

The B777 aircraft was flown on both ETOPS and non ETOPS sectors; the type of flight, ETOPS or non ETOPS is recorded, but is not immediately available without some work. The aircraft route structure in that time was nearly all long range flying, and all the aircraft were maintained at ETOPS standards, so the precise nature of the flight rules is not relevant. It is therefore legitimate to treat all the B777 sectors as if they were in fact ETOPS sectors.

We do not record whether the diversion was initiated within the ETOPS area. I have tried to estimate from the description whether the event started in the ETOPS segment, but this is neither easy nor accurate. Where the diversion is to a remote airfield or to one near a typical ETOPS boundary, I have assumed that the event was in the ETOPS area, unless it seems that the diversion was for operational reasons (e.g. crew duty time). ON balance this should slightly overestimate the number of events within the ETOPS area.

1. B777 Diversions:

Weather 17
Medical 68
Operations 21
Technical 22
Security 11 (includes disruptive pax and Sept 11)

Total 138

of which :

45 within ETOPS segment
38 Medical AND within ETOPS segment
3 Technical AND engine related (rest = toilets, smoke, windscreens etc)
4 Technical AND ETOPS segment
1 Technical AND ETOPS segment AND Engine related

Total sectors = 125,000 (approx)

Diversion Aerodromes used - see spreadsheet - number in Siberia = 0

2. B747-400 Diversions
Weather 20
Medical 82
Operational 14
Technical 32
Security 12

Of which;

10 Technical AND engine related. In all but 2 cases, the diversion was the result of insufficient fuel to complete the planned operation with adequate reserves as determined by the crew, or on company request due to subsequent dispatch difficulty. The two exceptions requiring a prompt landing were 1 severe vibration and Reverse unlocked indication, and 1 severe fuel leak.

Diversion Aerodrome used - see spreadsheet - number in Siberia = 0

Total Sectors = 130,000 (approx)

Annex 2 to RIA

Airbus Traffic Forecasts

Airbus traffic forecast data are based on an economic model that takes into account the following factors:

- Economic growth by region
- Region to region passenger flow as a function of population density, GDP and inter-regional commercial relations
- Anticipated evolution of oil prices
- Passengers preferences between stop-flights, connection flights and direct flights
- Standard 10 years economic cycles

This model does not include freighter traffic.

1- North America - Europe

Year	A/C size	Nr a/c	Monthly freq	Yearly Freq
2002	100-210	164.3	7,807	94,988
	250	148.7	6,871	83,601
	300-400	149.9	6,902	83,973
	VLA	11.3	525	6,386
2002 Total		474.3	22,105	268,948
2012	100-210	223.0	10,931	132,993
	250	191.1	9,090	110,599
	300-400	263.3	12,386	150,701
	VLA	61.1	2,872	34,943
2012 Total		738.6	35,280	429,235
2022	100-210	237.9	12,018	146,223
	250	203.0	9,973	121,338
	300-400	359.3	17,185	209,088
	VLA	145.7	7,142	86,894
2022 Total		945.8	46,319	563,543

2 - Europe - Northeast Asia via Siberia route

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	100-210	5.1	205	2,489
	250	33.9	1,279	15,564
	300-400	67.8	2,489	30,278
	VLA	1.7	66	799
2002 Total		108.5	4,038	49,130
2012	100-210	8.5	351	4,264
	250	50.7	2,033	24,734
	300-400	99.9	3,794	46,157
	VLA	27.1	965	11,743
2012 Total		186.1	7,142	86,898
2022	100-210	8.2	357	4,342
	250	58.1	2,421	29,457
	300-400	96.7	3,860	46,961
	VLA	86.7	3,276	39,859
2022 Total		249.6	9,914	120,619

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	250	1.3	48	586
	300-400	1.0	37	449
	VLA	0.7	25	303

2002 Total		3.0	110	1,338
2012	250	2.3	86	1,040
	300-400	1.7	65	793
	VLA	1.1	44	538
2012 Total		5.2	195	2,371
2022	250	2.8	106	1,291
	300-400	2.0	79	956
	VLA	2.8	111	1,347
2022 Total		7.6	295	3,594

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	100-210	8.2	302	3,673
	250	27.2	897	10,917
	300-400	120.3	4,051	49,290
	VLA	2.0	82	1,000
2002 Total		157.9	5,333	64,880
2012	100-210	12.1	472	5,746
	250	36.5	1,209	14,710
	300-400	195.6	6,726	81,838
	VLA	26.9	960	11,685
2012 Total		271.1	9,368	113,979
2022	100-210	11.2	472	5,748
	250	29.8	1,072	13,038
	300-400	188.9	6,568	79,912
	VLA	144.2	5,065	61,624
2022 Total		374.1	13,177	160,321

5 - North America - Asia via Polar routes

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	100-210	3.7	196	2,382
	250	5.8	251	3,050
	300-400	21.7	854	10,395
	VLA	5.0	189	2,300
2002 Total		36.2	1,490	18,127
2012	100-210	6.4	342	4,165
	250	9.5	424	5,159
	300-400	37.7	1,521	18,501
	VLA	9.4	366	4,450
2012 Total		63.0	2,653	32,275
2022	100-210	9.1	507	6,164
	250	13.4	618	7,525
	300-400	56.7	2,333	28,379
	VLA	13.9	555	6,754
2022 Total		93.1	4,013	48,822

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	100-210	2.6	114	1,387
	250	2.4	99	1,203
	300-400	19.3	622	7,562
	VLA	1.1	41	494
2002 Total		25.4	875	10,646

2012	100-210	4.5	201	2,443
	250	3.0	134	1,628
	300-400	27.2	904	10,993
	VLA	6.6	218	2,657
2012 Total		41.2	1,457	17,721
2022	100-210	7.1	326	3,961
	250	4.2	206	2,503
	300-400	25.5	899	10,937
	VLA	20.3	664	8,076
2022 Total		57.0	2,094	25,477

7 - Austral Africa - South America

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	250	0.4	13	156
	300-400	1.4	51	623
2002 Total		1.8	64	779
2012	250	0.7	22	273
	300-400	2.4	91	1,108
2012 Total		3.0	114	1,381
2022	250	0.9	32	385
	300-400	3.5	138	1,676
2022 Total		4.4	169	2,062

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	100-210	0.2	14	175
	250	0.9	37	448
	300-400	0.2	10	119
2002 Total		1.3	61	742
2012	100-210	0.3	22	268
	250	1.8	71	862
	300-400	0.4	20	238
2012 Total		2.5	112	1,368
2022	100-210	0.4	30	366
	250	2.7	107	1,305
	300-400	0.6	30	362
2022 Total		3.7	167	2,034

9 - Austral Africa - Australia-New Zealand

Year	A/C size	Nr a/c	Monthly Freq	Yearly Freq
2002	250	0.2	8	96
	300-400	2.1	72	877
2002 Total		2.4	80	973
2012	250	0.4	15	185
	300-400	4.1	140	1,698
2012 Total		4.5	155	1,883
2022	250	0.6	24	288
	300-400	6.2	218	2,653
2022 Total		6.9	242	2,940

Annex 3 to RIA

AEA: Evaluation of the potential Costs and Benefits induced by the ETOPS/JAA proposal for two-engined aircraft

Purpose of this evaluation

This is not a cost/benefit analysis as such, it is a list of the potential costs and benefits which can be induced by the JAA/EASA ETOPS draft text.
Generally speaking, the ETOPS operations could be impacted, depending on text interpretation, but are no more limited to 180 minutes and there are some alleviations.

Applicable Operational Requirements	**Non ETOPS Flights or ETOPS operations below 180 mn**	**ETOPS >180 mn**	**Comments**
The AFM will include the Maximum Approved Diversion Time (MADT) (Proposed JAR OPS 1 change : JAR OPS 1.244 (11)) (See EASA AMC 20-6).	ETOPS<180 = Not clear if it is applicable or not to ETOPS <180. Considering yes means system evaluation by the (S) TC holder .	Same as for ETOPS<180 mn. Is a recertification requested for existing ETOPS aircraft in order to operate them above 180 mn?	Means Aircraft Flight Manual modification without transition period. Nevertheless the text speaks about one MADT for the aircraft and one for the engine. EASA AMC 20-6 says that ETOPS type design of already certified aircraft remain valid, does it means no need to modify the AFM with MADT?
Area specific Operators Approved Diversion Time granted by the Authority (See proposed AMC OPS 1.246 and EASA AMC 20-6).	Already requested today.	ETOPS>180 mn was not allowed. This alleviation is subject to conditions like to already hold a 180 mn ETOPS approval (AMC OPS 1.246).	Possibility to have an ETOPS alternate beyond 180 mn.
Flight Planning software modification To check with the weather forecast if the MADT is exceeded or not.	Appendix C8 request such check at the flight planning stage but Appendix C4 (ETOPS<180) does not request that.	Requested in Appendix C5 and C8 for ETOPS>180	If the Operator approved diversion time is close from the MADT then in case of headwind, limitations can occur which are not taken into account for today ETOPS<180 mn. This means rerouting and then additional fuel. Cost induced by flight planning software modification.

Fire extinguishing system retrofit.	Already part of the certified ETOPS diversion time.	Possible modification in order to get more than 180mn.	Already part of the ETOPS certification. EASA AMC 20-6 says that this “capacity/endurance can be based on the all-engines operating speed in still air ». Does that means that it is rather a distance than a time? (clarification needed).
RFFS level 7 for the LROPS alternate aerodromes (Proposed change to JAR OPS 1.220 § 1.2 iii and 1.244 (1)).	RFFS level 4 accepted as it is today.	Level 7 RFFS is requested for the ETOPS alternate. To be compared to the level 4 requested today for ETOPS operations below 180 mn.	For ETOPS operations the RFFS level 4 was used and there has been problems in the past with RFFS level change. With level 7 RFFS, the alternates selection criteria is increased regarding the ETOPS experience. Risk is not to be able to find and maintain an aerodrome with the correct RFFS level.
Flight follow up (AMC OPS 1.246)	Already existing	Already existing for ETOPS<180 mn.	
Flight crew training (Proposed JAR OPS change : AMC OPS 1.975 Route and aerodrome competence qualification) (Appendix 4 to AMC OPS 1.246).	Additional items like recovery plan are not addressed in this NPA.	Referring to ETOPS<180mn , additional items like recovery plan are not addressed by this ANP.	Initial and recurrent training. A priori ground course modification plus simulator requested for recovery plan training are not addressed by this NPA.
Flight dispatcher training (appendix 4 to AMC OPS 1.246) (Appendix 5 to AMC OPS 1.246).	Ground course modified with additional items like recovery plan are not addressed in this NPA.	Reffering to ETOPS<180mn , additional items like recovery plan are not addressed in this NPA.	Initial and recurrent. Request additional ground training for operations and recovery plan are not addressed in this NPA..

Maintenance (EASA AMC -20)	To be checked if additional items or alleviation.	To be checked if additional items or alleviation.	Includes mechanics training, administrative actions, reliability follow up, additional or extended ground check, etc.
MEL (See proposed AMC OPS 1.246 and appendixes to AMC OPS 1.246).	Approved ETOPS MEL already in place. Check if different from todays requirements.	no further recomendations for ETOPS>180 mn Expanded Medical Kit are addressed iin this NPA.	To be checked
Authorization management (AMC OPS 1.246)	Approval already granted, but additional workload due to additional requirements like Recovery Plan (see below). Recovery plan is not addressed by this NPA.	Additional workload due to anoter approval to be asked in addition to the ETOPS 180 mn approval which is a pre requisite.	The management of authorisations implies a workload and a follow up of these authorisations (Authority audits, inspection, documentation change, etc.).
Recovery plan Recovery plan is not addressed by this NPA.	New requirement which implies the Authority approval. Recovery plan is not addressed by this NPA.	New requirement which implies the Authority approval. Recovery plan is not addressed by this NPA.	Gathering data, establishing procedures, Approval management, One audit per year is requested which is a cost Recovery plan is not addressed by this NPA.

New adequate aerodrome definition. (Proposed JAR OPS 1 change : JAR OPS 1.220, 1.244)	The adequate aerodromes criteria are increased and must take into account data not subject to AIP publications.	The adequate aerodromes criteria are increased and must take into account data not subject to AIP publications. For ETOPS>180mn, the RFFS level is 7 which is another possible cause of re-routing.	This impact All the aerodromes used (i.e.departure, arrival, alternates) which are located into a severe climate area. Means to demonstrate for all these aerodromes even the departure arrival where obviously there is passenger facilities, that measures are in place. Risk that the ETOPS area may vary due to the new non AIP data requirement. The RFFS level increase is another parameter which can be downgraded quickly by the airport.
Validation flight (AMC OPS 1.246 and EASA AMC 20-6)	Requested even for operators with ETOPS experience.	Requested for operators with ETOPS experience (to get a more than 180 mn approval, the operator must have a 180 mn ETOPS approval).	Flight requested before the approval delivery, does it means a non revenue flight (high cost).
Proposed change to JAR OPS 1.245 (b)	Simplification of the one engine speed computation which is then less penalising.	Simplification of the one engine speed computation which is then less penalising.	
Fuel critical scenario	* Less fuel for Icing * Less fuel for diversion : no go around. * 5% wind factor should be less penalizing	* Less fuel for Icing * Less fuel for diversion : no go around. * 5% wind factor should be less penalizing	
Safety			

Annex 4 to RIA

Information provided by Dassault

DASSAULT AVIATION
DIRECTION GÉNÉRALE TECHNIQUE

Division **FALCON**

Mérignac, September 22th, 2004

DGT-DTF/NAV 296304
LH

TO :

M.	MORIER Yves	CJAA	Hoofddorp

COPIE(S) :

MM.	MARCOU Bernard	DAC Nord	Orly
	QUET André	Airbus	Toulouse

Please contact Louis HUCHER Tél : +33 (0)55 613 9322 Fax : +33 (0)55 613 9187

SUBJECT : ETOPS / LROPS – Dassault Aviation contribution to RIA

Dear M. Morier,

This letter is the contribution of Dassault Aviation to the Regulatory Impact Assessment – RIA – regarding the future European regulation governing Extended Operations – ETOPS – and Long Range Operations – LROPS – of Business Jets, as defined in the draft guidance material GAI-20 ACJ 20X6 Section 3 dated 06-jun-03.

This draft guidance material is applicable to two, three and four engines aeroplanes with 19 passengers or less and a take-off mass of less than 45 360 Kg operated over a route that contains a point further than 180 minutes flying time at the approved one-engine inoperative cruise speed from an adequate airport. These operations are called ETOPS for two engine aeroplanes, and LROPS for three and four engine aeroplanes.

Although the GAI-20 ACJ 20X6 Section 3 contains provisions for operations between 120 and 180 minutes for twins, we have concentrated our study on extra-design costs that would be induced to comply to operations beyond 180 minutes only for two and three engine aeroplanes. This constitute the first part of this letter.

The second part of this letter gives the ratio between private and public passenger transportation for European registered aeroplanes, and capable of flying 12 hours or more (cargo freighter transportation can be neglected), and also an assessment of this ratio over the next twenty years. The assessment of Operator’s costs to comply with operational requirements is not presented, but data provided in the FAA ETOPS NPRM, or data applicable to aircraft with more than 20 passenger seats, can form a good basis.

1. Extra-design costs induced by future European ETOPS / LROPS regulation

Due to the fact that existing two engine aeroplanes and three engine aeroplanes will not be considered on the same design criteria – refer to paragraph 3A.6 “Applicability” of the ACJ 20X6 Section 3 – this study has been divided in two parts to distinguish two and three engine aeroplanes.

1/5

DASSAULT AVIATION Division FALCON

1.1 Two engine aeroplanes

- Assessment of all time-limited systems in normal and degraded system configurations in the order of 20 k€ per aeroplane. Any design change found necessary as a result of this assessment would increase this cost.
- Full numerical system safety assessment of all aeroplane systems, using the maximum duration of an ETOPS mission and maximum diversion time for Group 1 systems, in the order of 5 k€ per aeroplane. Any design change found necessary as a result of this assessment would increase this cost.
- Flight test demonstration of the handling quality with ice shapes on unprotected airframe surfaces beyond the thickness required for compliance with Section 25.1419 and Part 25 Appendix C, up to the most critical thickness that may be encountered during an ETOPS diversion at 10,000 ft, in the order of 540 k€ per aeroplane family. Any design change found necessary as a result of this assessment would increase this cost. The flight test is a very high-risk test because of the need to takeoff with the simulated ice shapes on the wing. Aeroplanes with airfoil that present more sensitivity to ice build-up may not pass the test.
- Fuel alerts for all system malfunctions and operational errors in the order of 1,200 k€ per aeroplane. The cost of a full installation will be in the order of 20 k€ per aeroplane.
- Installation of new cargo fire protection system on aeroplane with only 15 minutes margin versus diversion time in still air ISA conditions. No cost for Dassault Aviation eligible aeroplanes as they all have a Class B cargo compartment. Retrofit cost may have to be considered for operators of other makes of ETOPS aeroplanes.
- Installation of a further (4th) power source that is capable of providing power to the essential functions for continuous safe flight and landing in the order of 400 k€ per aeroplane. The cost of a full installation will be in the order of 100 k€ per aeroplane.
- Update of aeroplane documentation in the order of 700 k€ per aeroplane.
- Propulsion system validation test in the order of 1,500 k€ per airframe-engine combination.

1.2 Three engine aeroplanes

- Update of aeroplane documentation in the order of 700 k€ per aeroplane.

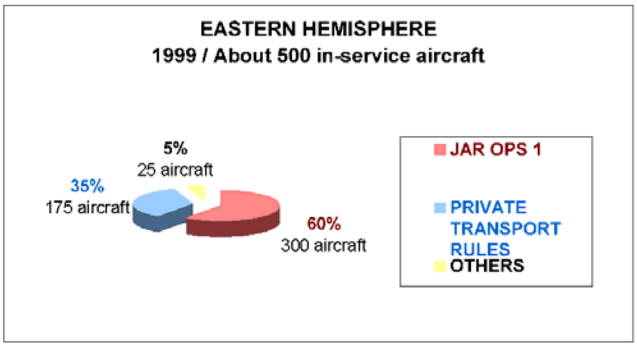
2. Fleet status and expected evolution

2.1 Commercial vs Private Operations

In 2004, the number of Falcon aircraft operated worldwide is about 1600 aircraft.

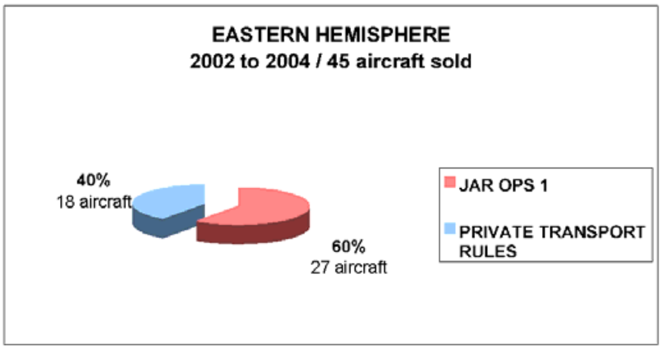
In 1999, at the introduction of the JAR-OPS 1 in Europe, about 1350 aircraft were operated worldwide.
A third of them (i.e. 500 aircraft) were operated in the eastern hemisphere :

- About 60% of eastern hemisphere aircraft were operated under private rules (300 aircraft)
- About 35% under JAR OPS 1 (175 aircraft)
- About 5% under other rules, e.g. military or state aircraft (25 aircraft)



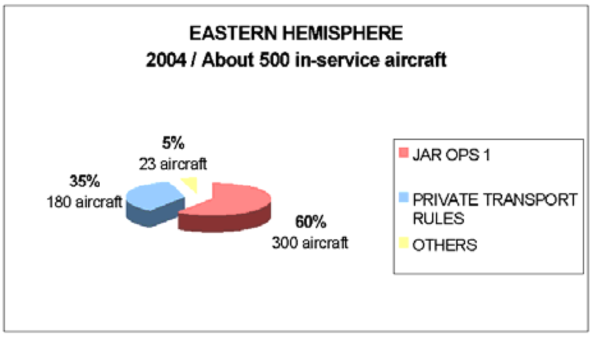
In the past 3 years (2000-2003), among the 45 aircraft sold in the eastern hemisphere :

- About 60% were to be operated under public transport rules (27 aircraft)
- About 40% were to be operated under private rules (18 aircraft)



Compared to 1999, the percentage of commercial vs private operations in 2004 in the eastern hemisphere has not really changed, as shown in the following diagram :

DASSAULT AVIATION Division FALCON

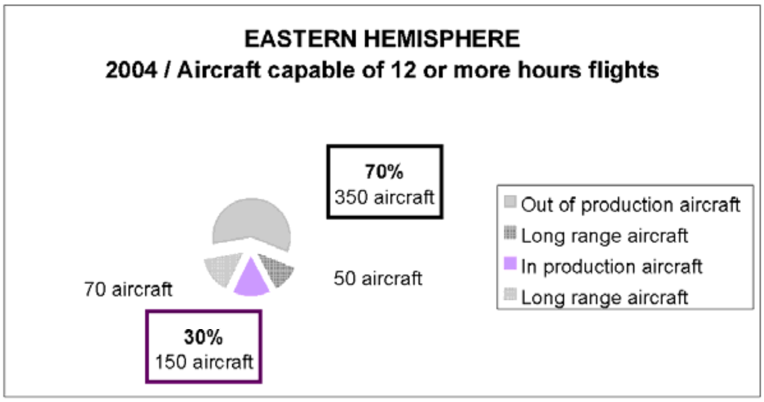


Nevertheless we surely expect the trend to operate more and more aircraft under JAR OPS 1 rules to accentuate in the following decade, especially if the future regulation dedicated to business operations does not offer taxes advantages to the operators.

2.2 Aircraft capable of flights equal or greater than 12 hours

As said previously, in 2004, the number of Falcon aircraft operated worldwide is about 1600 aircraft : about 500 are operated in the eastern hemisphere.

The percentage of large bodied long range aircraft (whose range is between 3900 and 4200 Nm) capable of flying 12 hours or more non-stop is less than 25% of the current eastern hemisphere in service fleet (120 aircraft).



Nevertheless we are aware that only 10% of the missions with these aircraft effectively last more than 12 hours. To our knowledge, as of today, none of these flights are commercial.

Considering only the in-production aircraft (that represent 30% of the fleet), the Falcon business aircraft fleet should grow about 3% per year within the next 10 years (trend is confirmed by the "ICAO

DASSAULT AVIATION Division FALCON

forecasts for airline traffic to the year 2010" - +3.7% of aircraft kilometers per year; +2.5% of aircraft departures per year).

According to our worldwide selling previsions, the part of long range and ultra long range aircraft should increase up to about 30% of the Falcon sold in 10 years :

- In 2014 : among 370 in production aircraft, operated in the eastern hemisphere : 33% will be capable of long range flights of 12 hours or more (i.e. about 120 aircraft)
- In 2014 : among out of production aircraft, 50 aircraft will be capable of flying 12 hours or more
- **Let 's say 170 aircraft operated in the eastern hemisphere, will be capable of flying 12 hours or more in 2014. A majority of them will be flying under commercial rules. It does not mean they will all make ETOPS / LROPS flights.**

We also have to bear in mind that the business aviation market growth is closely related to the economic growth : as a consequence, business flights between Europe and South America / Caribbean, and between Europe and Asia / Pacific or between North America and Asia / Pacific are expected to increase more rapidly than between other areas of the world (about 7.5% between these regions compared to 5% in the rest of the world).

Several city pairs in those regions could possibly make that Falcon operators are interested in ETOPS / LROPS flights to save time. Even if, as of today, very few Falcon missions are of more than 12 hours, it could concern more and more missions in the future.

Best Regards,

[Original Signed] *[Original Signed]*

L. HUCHER **C. GIRAUDEAU**

DGT-DTF/NAV 296304 5/5

<u>Annex 5 to RIA</u>

IFALPA input

From a purely regulatory standpoint, the FAA, JAA and ICAO have accepted that the cabin depressurization is a condition that all operators must consider. In the United States FAR 121.329 requires for 3 and 4 engine aeroplanes that adequate provisions be made for oxygen considering descent to an altitude that will allow successful termination of the flight. Except for two engine aeroplanes operating under AC 120-42A, there is no explicit requirement for an operator of 3 & 4 engine aeroplanes to check the conditions at the airport where the flight will terminate or check for fuel sufficiency. Even though there have been no explicit regulations, the industry has not had too many unfortunate incidents because most of the routes airlines have been operating have been over areas with an adequate number of alternate airports.

The JAA also has similar requirement for oxygen. In addition the JAA under AMC OPS 1.255 section 1.6(b) requires airlines to provision fuel for 'possible failure of power unit or loss of pressurization...' Since the fuel required under possible failure of power unit is less than fuel that would be required if there were a loss of pressurization, it is quite common for operators to provision fuel based on engine failure only.

Point to point operations using aeroplanes with very long ranges are now getting quite common. The RIA itself says that Polar flights will increase to 39,000 flights per year by 2010 and this could result in at least 6 diversions on Arctic routes every year! This new flying is also opening routes that over fly remote areas of the world with limited alternates in the immediate vicinity of the routes. A study was done by a major U.S. manufacturer using a 747-400 carrying normal route planning fuel reserves. On a route that is 16 hours long (an example is Perth to Buenos Aires or Santiago which is shown by Airbus in their LROPS CD), if a four engine aeroplane has a major decompression anywhere in the cruise phase between approximately 7.25 hours to 12.5 hours the aeroplane will not have sufficient fuel to descend and cruise at 10,000 ft and reach its point of origin or destination. This has the potential for significant loss of life. The U.S. Government Accounting Office (GAO) has estimated the cost of an accident with a four-engine aeroplane with about 400 passengers to be around $1.5 billion.

If extended range operations regulations are adopted, they would require aeroplanes operating on these routes that overfly remote areas of the world, i.e., requiring more than 3 hours diversion (a distance of over 1500 nm for a 747), to assure there is an alternate where the aeroplane can divert to and there is sufficient fuel on board to reach that airport. This proactive measure strives to minimize diversions and if they do occur, could avoid loss of lives and save possibly up to $1.5b

A similar calculation for a 10 hour flight shows that between 4.5 to 7.5 hours that same aircraft would not have enough fuel to be able to continue to its destination or turn back to it's origination. If it did not have a suitable alternate that it could land at the results would be catastrophic. This exposure is pretty significant if there are no alternates.

Even a successful divert has costs. The generally acceptable figure for the cost of a divert by a commercial airliner is between $89400 and $181, 800. This cost is given in the FAA NPRM (pg 64779). Given the figures in the RIA, the industry should expect to incur a minimum of ½ million dollars a year in the Polar area alone. And that is if they are all successful. The last 20 years of ETOPS shows how the program has minimized the number of diversions. There is no reason why adopting LROPS which has the same basic elements as ETOPS would not cut down the number of potential diversions. Even if the 6 diversions in the polar area were to be halved due to LROPS, it would save the airlines at least $1.5 million per year.

Undoubtedly the situation would be worse if the diverts were unsuccessful because no one had planned alternates/fuel for a diversion. Some studies describe the accepted values of unsuccessful diverts. The data is expressed in terms of personal injury and death with the accepted value of a fatality between $3-5 million. If one assumes a 400 passenger aircraft one can easily see where the $1.5 billion figure comes from.

Value of a human life = $3 million, Office of Secretary of Transportation

OMB guidance to FAA, certain criteria, can use $5million (OMB Circular A4, new guidelines for conduct of regulatory analysis, Sept 2003)

OST memo revised department guidance, Jan 2002
Fatal $3 million
Critical 76.25% of fatal
Severe 18.75 % of fatal

Serious 5.75% of fatal
Moderate 1.55% of fatal
Minor 0.2% of fatal

Per victim medical and legal costs

Fatal -	Medical	$52,600
Legal	80,100	
Dir total	132,700	

Apply same percentages as above for non-fatal events

See also the reports from the FAA Aviation Rulemaking Cost Committee references @
http://apo.faa.gov/arcc/021122%20Meeting/Handouts/Charter/..%5C..%5C..%5CResearch.htm
Specifically, the draft report "Economic Values for FAA Investment and Regulatory Decisions, A Guide"

According to DOT Volpe Research Center
17.4 million dollars/jet hull loss
3.84 million dollars/turbo prop hull loss
Indirect costs associated with accidents = 4 x hull loss value

Annex 6 to RIA

Table 1
Review of World Airline Accident Summary (1990-2003)
Accidents to large transport aeroplanes involving a diversion

Date	Aeroplane type	Comments	fatalities
04/021990	Boeing 727	Loss of engine en route	N
13/01/1990	Tupolev 134	Smoke in rear cargo hold. Forced landing	Y
13/06/1990	Fokker 28	Gear would not extend. Divert to nearby airport	N
14/07/1990	Lockheed 188	Propeller runaway. Divert	N
21/08/1990	Boeing 737	Landing gear would not extend. Diversion.	N
04/09/1990	Lockheed 188	Landing gear would not extend. Diversion	N
17/11/1990	Tupolev 154	In flight fire. Diversion. Forced landing	N
21/11/1990	Iliushin 62	Diversion due to fog. Overran short runway	N
08/05/1991	Boeing 727	Landed with gear outside the runway. Go-around. Diversion. Safe landing	N
26/06/1991	BAe 1-11	Navigational error in bad weather. Diversion. Could not find alternate (closed). Forced landing	Y
05/11/1991	BAe 146	Uncontained engine failure. Diversion. Safe landing	N
12/12/1991	Boeing 747	Loss of control. Regained control. Diversion. Safe landing	N
31/03/1992	Boeing 707	Strong turbulence. Two engines torn away. Diversion. Veered-off runway	N
14/07/1992	Antonov 12	Holding pattern. Sand storm. Crashed during diversion	Y
22/10/1992	Boeing 737	Damaged by hail in flight. Diversion. Safe landing	N
09/12/1992	DC-8	Turbulence. One engine torn away. Diversion. Safe landing	N
31/01/1993	Boeing 707	Hydraulic failure. Diversion. Landing gear retracted on landing	N
06/04/1993	MD-11	Loss of control. Diverted to Shemyia	Y (Due to loss of control)
04/07/1993	Boeing 747	Incorrectly latched pallet impacted rear pressure bulkhead. Los of pressurization. Diversion	N
20/11/1993	Yak 42	Divert to Ohrig due to bad weather in Skopje. CFIT during missed approach at Ohrig	Y
25/04/1994	Vickers Viscount	Two engine failure. Severe icing. Electrical failure. Diversion. Forced landing	Y
02/04/1994	Boeing 727	Landing gear would not extend. Diversion. Safe landing	N
11/12/1994	Boeing 747	Bomb explosion. Diversion. Safe landing.	N
21/12/1994	Boeing 737	Diversion due to bad weather. Undershot at alternate.	Y
14/03/1995	Antonov 12	Low fuel. Diversion. Missed approach. Fuel exhaustion. Forced landing	N

Date	Aeroplane type	Comments	fatalities
31/08/1995	Antonov 26	Low fuel. Diversion. Crashed 4km short of alternate.	Y
30/04/1996	Boeing 737	Undercarriage problems. Diversion. Safe landing.	N
14/05/1996	DC-9	Lost en route. Diversion. Fuel exhaustion. Undershot at alternate	N
31.05.1996	Boeing 747	Passenger sick. Diversion. Safe landing. Damaged during ramp incident.	N
05/09/1996	DC-10	Smoke warning. Diversion. Emergency descent. Smoke in cockpit. Safe landing	N
28/10/1996	MD-82	Landing gear would not extend. Diversion. Safe landing	N
03/01/1997	Short 330	Hard landing following diversion due to fog at destination	N
21/05/1997	Embraer 120	Engine failure followed by fire. Hydraulic failure. Diversion.. Overran runway	N
17/11/1997	Fokker 28	Problems with lift dumpers and anti-skid. Diversion. Veered-off runway.	N
01/01/1998	Boeing 757	Struck the ground during go-around. Diversion. Safe landing	N
05/01/1998	Fokker 100	Diversion due to poor weather at destination. Landed 11 km short of alternate	N
13/01/1998	Antonov 32	CFIT during last diversion	Y
03/03/1998	BAe HS-748	Undercarriage problem. Diversion. Safe landing.	N
10/03/1998	BAe 146	Windshear? Struck trees. Go-around. Hydraulic failure. Diversion. Safe landing	N
24/08/1998	Boeing 737	Hail damage in-flight. Diversion. Safe landing.	N
06/04/1998	BAe ATP	Landing gear problems. Diversion. Safe landing	N
25/04/1998	Short 330	Diversion due to weather at destination. Overran runway at alternate.	N
07/05/1998	DC-9	Damage due to hail in flight. Diversion. Safe landing	N
05/08/1998	Boeing 747	Diversion due to bad weather at alternate. Veered-off runway at alternate. Thrust reversers asymmetry	N
24/08/1998	Fokker 27	Several diversions due to bad weather. CFIT during the last one	Y
02/09/1998	MD-11	Smoke alarm. Diversion. Too heavy to land. Decision to hold. Major fire developed. Aeroplane crashed in the water	Y
24/10/1998	Antonov 12	Diversion for unknown reasons	Y

Date	Aeroplane type	Comments	fatalities
21/05/1999	Boeing 737	Entered volcanic ash cloud. Diversion. Safe landing	N
10/12/1999	Lockheed C-130 E	Military aeroplane. Hard landing. Diversion. Successful belly landing	Y (Due to hard landing)
19/03/2000	Boeing 727	Undercarriage problems. Diversion Safe landing	N
12/07/200	Airbus 310	Flight continued with undercarriage not fully retracted. Fuel low. Diversion. Fuel exhaustion. Landed short from runway (500 m)	N
21/09/2000	Boeing 707	Smoke. Emergency descent. Diversion. Smoke increase. Electrical problems. Hard landing. Veered-off runway.	N
01/10/200	DC-10	Engine trouble. Diversion. Safe landing	N
10/10/2000	ATR 42	Diversion due to bad weather at destination. Windshear on landing at alternate. Several bounces during landing	N
31/01/2001	Se-210 Caravelle	Undershot at destination. Go-around. Diversion. Hydraulic failure. Power loss. Forced landing. Caught fire,	Y
08/03/2001	Boeing 757	Hard landing on a previous flight. Released following inspection. Undercarriage do not retract during subsequent flight. Diversion. Safe landing.	N
04/04/2001	Antonov 32	Propeller torn away. Diversion. Safe landing	N
17/05/2001	Yak 40	CFIT during last diversion.	Y
04/08/2001	Boeing 737	Engine problem. Diversion. Holding pattern due to weather. Fire in engine. Request immediate landing. Safe landing.	N
09/08/2001	Boeing 717	Undercarriage problems. Diversion. Safe landing.	N
24/08/2001	Airbus 330	Fuel problem. Diversion. Engine flame out at 85 NM from airport. Safe landing	N
15/09/2001	Fokker 100	Engine uncontained failure during cruise. Depressurization. Emergency descent. Diversion. Safe landing.	Y (due to uncontained failure)
17/12/2001	Boeing 737	Diversion due to bad weather at destination. Undershot at alternate. Emergency evacuation.	N
04/07/2002	Boeing 707	Declared emergency in flight. Diversion. Crashed 4Km from runway. It seems that the undercarriage did not retract after take-off and that fuel was exhausted.	Y
10/07/2002	Saab 2000	Several diversions due to weather. Fuel low. Diverted to general Aviation airport. Landed on a disused runway.	N
30/08/2002	Fokker 100	Fuel loss in flight. Diversion. Forced landing.	N
30/08/2002	Fokker 100	Hydraulic failure. Undercarriage does not extend. Diversion. Safe belly landing	N
17/01/2003	Antonov 24	Total electrical failure. Diversion. Unable to find airport. Fuel exhaustion. Crashed.	Y
08/03/2003	Fokker 27	Undercarriage does not fully extend. Diversion. Safe landing.	N

Annex 7 to RIA

Differences between EASA and FAA proposals relative to Design

In principle technical harmonisation has been achieved in the majority of the aspects. However, in the FAA the technical requirements related to design are rules (FAR-25) where in this proposal they are acceptable means of compliance. Main differences between this NPA and the recently published FAA rule for ETOPS are summarized below:

I. 14 CFR Part 21 Certification procedures for products and parts

§ 21.4 ETOPS reporting requirements –

(a) Applies only to ETOPS approval without service experience. Experience shows that most ETOPS approvals of derivatives aeroplanes are based on a combination of previous service experience, testing and analysis, which contains some portion of early ETOPS.
This seems to be recognised in paragraph (a) (4), which considers derivative aeroplanes and engines.
The words "early ETOPS" and "without service experience" give the wrong impression of a applicability restricted to new types whereas in reality it applies to a large number of derivatives, (even fuselage stretching goes with a change in engine rating).
EASA/JAA consider that the ETOPS reporting requirements should apply to all manufacturers holding an ETOPS approval. Therefore, no specific reference to word 'early' is in the proposal to amend EC regulation 1702/2003..

§ (b) (2) (ii) and (iii)- With regard to the 207 mn exception, there is no current specific EASA/JAA material to cover 207 minutes as a 15% extension to 180minutes. However, draft material was developed by EASA/JAA, but this material was never used as there was no specific need identified in Europe. EASA/JAA believe that material developed for diversions greater than 180 minutes should apply. The FAA material for 207 minutes permits operations beyond 180 minutes with engine reliability levels which in theory could be half the levels that the FAA specifies for ETOPS (twins) with greater than 180 minutes diversion times.
Although EASA/JAA agree to set IFSD rates targets, it is believed that these targets should not be specified in a rule such as part 21as it creates immediate non compliance in case of excessive IFSD rate, in particular in the early life of the aeroplane.

II. 14 CFR Part 25 Aeroplane type design

FAR 25 Amdt. 120	Draft EASA NPA
Sec. 25.3 Special provisions for ETOPS type design approvals ... (b) Aeroplanes with two engines. ... (2) For ETOPS type design approval of an aeroplane beyond 180 minutes an applicant must comply with Sec. 25.1535 Sec. 25.1535 ETOPS approval. [Except as provided in Sec. 25.3, each	CS-25.1535 ETOPS approval. Each applicant seeking approval for ETOPS must: . . . (see AMC 20-6 Part B).

FAR 25 Amdt. 120	Draft EASA NPA
applicant seeking ETOPS type design approval must comply with the provisions of Appendix K of this part.]	
Sec. 25.3 Special provisions for ETOPS type design approvals ... (b) Aeroplanes with two engines. ... (2) For ETOPS type design approval of an aeroplane beyond 180 minutes an applicant must comply with Sec. 25.1535 Sec. 25.1535 ETOPS approval. [Except as provided in Sec. 25.3, each applicant seeking ETOPS type design approval must comply with the provisions of Appendix K of this part.]	CS-25.1535 ETOPS approval. Each applicant seeking approval for ETOPS must: . . . (see AMC 20-6 Part B).
K25.1.1 Part 25 compliance. The aeroplane-engine combination must comply with the requirements of part 25 considering the maximum flight time and the longest diversion time for which the applicant seeks approval. K25.1.2 Human factors. An applicant must consider crew workload, operational implications, and the crew's and passengers' physiological needs during continued operation with failure effects for the longest diversion time for which it seeks approval.	CS-25.1535 ETOPS approval. Each applicant seeking approval for ETOPS must: (a) Comply with the requirements of CS25 considering the maximum mission time and the longest diversion time for which approval is being sought. (b) Consider crew workload and operational implications and the flight crew’s and passengers physiological needs of continued operation with failure effects for the longest diversion time for which approval is being sought. (c) Appropriate limitations should be established.

FAR 25 Amdt. 120	Draft EASA NPA
K25.1.3 Aeroplane systems. (a) Operation in icing conditions. (1) The aeroplane must be certificated for operation in icing conditions in accordance with Sec. 25.1419. (2) The aeroplane must be able to safely conduct an ETOPS diversion with the most critical ice accretion resulting from:	(13)Operation in icing conditions 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. (i) The aeroplane should be certificated for operation in icing conditions in accordance with CS 25.1419. (ii) The aeroplane should be capable of continued safe flight at engine inoperative and depressurisation altitudes, and landing in icing conditions.
(i) Icing conditions encountered at an altitude that the aeroplane would have to fly following an engine failure or cabin decompression. (ii) A 15-minute hold in the continuous maximum icing conditions specified in Appendix C of this part with a liquid water content factor of 1.0. (iii) Ice accumulated during approach and landing in the icing conditions specified in Appendix C of this part.	The extent of ice accumulation on unprotected surfaces should consider the maximum super cooled liquid water catch at one-engine inoperative and depressurisation cruise altitudes. Substantiated icing scenario(s) should be assumed to occur during the period of time when icing conditions are forecast. The icing episode(s) assumed should be agreed with the Agency. The probability of icing longer than that assumed, and agreed for the icing episode(s), in combination with the probability of the aeroplane having to operate in icing conditions (e.g. engine in-flight shut down or decompression) should be shown to be Extremely Improbable.

FAR 25 Amdt. 120	Draft EASA NPA
K25.1.3 Aeroplane systems. (b) Electrical power supply. The aeroplane must be equipped with at least three independent sources of electrical power. K25.1.3 Aeroplane systems. (b) Electrical power supply. The aeroplane must be equipped with at least three independent sources of electrical power. K25.1.3 Aeroplane systems. (b) Electrical power supply. The aeroplane must be equipped with at least three independent sources of electrical power.	(9) For ETOPS approvals of greater than 180 minutes, and in order to meet the safety objective (i.e. Extremely Improbable) associated with the total loss of electrical power, including in combination with an engine failure, ..., the following criteria should also be applied: ... (ii) To meet CS 25.1351(d), following the failure of any power source combined with the loss or failure of the other two sources, further power source(s) should be available that is (are) capable of providing power to the essential functions for continuous safe flight and landing.
K25.1.4 Propulsion systems. (a) Fuel system design. (2) For two-engine aeroplanes to be certificated for ETOPS beyond 180 minutes, one fuel boost pump in each main tank and at least one crossfeed valve, or other means for transferring fuel, must be powered by an independent electrical power source other than the three power sources required to comply with section K25.1.3(b) of this appendix. This requirement does not apply if the normal fuel boost pressure, crossfeed valve actuation, or fuel transfer capability is not provided by electrical power.	(11) Fuel system (i) The aeroplane fuel system should provide fuel pressure and flow to the engine(s) in accordance with CS 25.951 and 25.955 for any fuel pump power supply failure condition not shown to be Extremely Improbable. (ii) The fuel necessary to complete the ETOPS mission or during a diversion should be available to the operating engine(s) under any failure condition, other then fuel boost pump failures, not shown to be Extremely Improbable. (e.g. crossfeed valve failures, automatic fuel management system failures)

FAR 25 Amdt. 120	Draft EASA NPA
K25.1.4 Propulsion systems. (b) APU design. If an APU is needed to comply with this appendix, the applicant must demonstrate that: (1) The reliability of the APU is adequate to meet those requirements; and (2) If it is necessary that the APU be able to start in flight, it is able to start at any altitude up to the maximum operating altitude of the aeroplane, or 45,000 feet, whichever is lower, and run for the remainder of any flight .	(4) ... The APU should demonstrate the required* in-flight start reliability throughout the flight envelope, or an acceptable procedure demonstrated for starting and running the APU, (e.g. descent to allow start), taking account of all approved fuel types and temperatures. If this reliability cannot be demonstrated, it may be necessary to require continuous operation of the APU. * Compatible with overall safety objective but not less than 95%
K25.1.7 Aeroplane flight manual. The aeroplane flight manual must contain the following information applicable to the ETOPS type design approval: ... (d) The system time capability for the following: (1) The most limiting fire suppression system for Class C cargo or baggage compartments. (2) The most limiting ETOPS significant system other than fire suppression systems for Class C cargo or baggage compartments.	(12) Time limited system In addition to the Maximum Approved Diversion Time, diversion time may also be limited by the capacity of the cargo hold fire suppression system or other time limited systems determined by considering other relevant failures, such as an engine inoperative, and combinations of failures not shown to be Extremely Improbable. Time limited system capability, if any, must be defined and stated in the Aeroplane Flight Manual.
K25.2.1 Service experience method. ... (a) Service experience. The world fleet for the aeroplane-engine combination must accumulate a minimum of 250,000 engine-hours. The FAA may reduce this number of hours if the applicant identifies compensating factors that are acceptable to the FAA. The compensating factors may include experience on another aeroplane, but experience on the candidate aeroplane must make up a significant portion of the total service experience.	2.1.1 Service Experience There is justification for the view that modern propulsion systems achieve a stable reliability level by 100,000 engine hours for new types and 50,000 engine hours for derivatives. 3,000 to 4,000 engine hours is considered to be the necessary time in service for a specific unit to indicate problem areas. ...

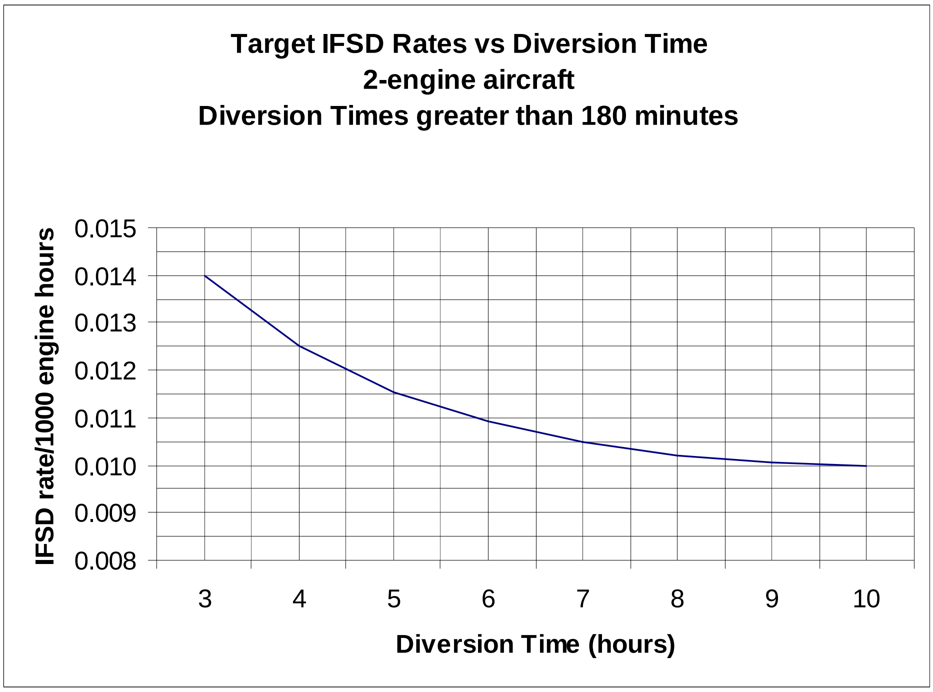
III. Difference regarding the IFSD rates

a) FAR 25 Amdt. 120

'K25.2.2 Early ETOPS method.
An applicant for ETOPS type design approval using the Early ETOPS method must comply with the following requirements:
...
(b) Propulsion system design.
(1) The engine used in the applicant's aeroplane design must be approved as eligible for Early ETOPS in accordance with Sec. 33.201 of this chapter.
(2) The applicant must design the propulsion system to preclude failures or malfunctions that could result in an IFSD. The applicant must show compliance with this requirement by analysis, test, in-service experience on other aeroplanes, or other means acceptable to the FAA.
If analysis is used, the applicant must show that the propulsion system design will minimize failures and malfunctions with the objective of achieving the following IFSD rates:
...
(ii) An IFSD rate of 0.01 or less per 1,000 world-fleet engine-hours for type design approval beyond 180 minutes.'

b) Draft EASA NPA Appendix 1 to EASA AMC 20-6

'3.3 For ETOPS with a Maximum Approved Diversion Time of greater than 180 minutes



IV. Additional EASA AMC for type design not covered by FAA rule

a) Analysis of Failure Effects and Reliability

(3) Airframe Systems

…
(iv) Cargo Compartment
... (2) 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. The capacity/endurance of the cargo compartment fire suppression system will be a factor in the determination of the Maximum Approved Diversion Time. **This capacity/endurance can be based on the all-engines operating cruise speed in still air.**

...

(vi) 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 e.g. **when the aeroplane is operating on standby electrical power only**.

b) Assessment of Failure Conditions

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

(3) Safety assessments should consider the flight consequences of single or Multiple system failures leading to a diversion, and the probability and consequences of subsequent failures or exhaustion of the capacity of time critical systems that might occur during the diversion. Safety assessments should determine whether a diversion should be conducted to the nearest airport or to an airport presenting better operating conditions, considering:

ii The effect of the initial failure condition on the capability of the aeroplane to cope with adverse conditions at the diversion airport, and

iii The means available to the crew to assess the extent and evolution of the situation during a prolonged diversion.

The aeroplane flight manual and the flight crew warning and alerting and display systems should provide clear information to enable the flight crew to determine when failure conditions are such that a diversion is necessary.’