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DRAFT REGULATORY IMPACT ASSESSMENT, INITIAL REGULATORY FLEXIBILITY DETERMINATION, TRADE IMPACT ASSESSMENT, AND UNFUNDED MANDATES

EXTENDED OPERATIONS (ETOPS) of MULTI-ENGINE AIRPLANES

Notice of Proposed Rulemaking (14 CFR Parts 1,21, 25, 33,121, 135)

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EXECUTIVE SUMMARY

This notice of proposed rulemaking would amend 14 CFR parts 1, 21, 25, 33, 121, and 135 to regulate extended range operations by all classes of operators. The NPRM would codify current practices that permit certificated air carriers to operate two-engine airplanes over routes with points more than one hour from an adequate airport through a deviation from section 121.161. These extended range operations have been known as ETOPS. The proposed rule would extend the appropriate safety standards and procedures developed over a 18-year period for two-engine air carrier ETOPS operations to all air carriers regardless of the number of engines and to business aircraft operators on routes beyond 180 minutes from a diversion airport. The proposed regulations would safeguard extended range operations for all operators by codifying and expanding the requirements for airframe and engine manufacturers.

The decision to engage in ETOPS operations is voluntary for both operators and manufacturers. Since the decision is voluntary, the FAA has estimated the cost to current ETOPS operators for the cost of provisions not incurred by current practices and has estimated the cost savings and costs to individual operators, and airframe and engine manufacturers. The FAA has also estimated the total cost to industry based on a set of assumptions as to the number of operators and airplane manufacturers that would voluntarily participate.

All the individual ETOPS operators would experience net cost savings due to the economies of more direct routes made possible by ETOPS and thus lower operating

costs. A new part 121 2-engine operator would have net cost savings of $10.3 million or $7.2 million, discounted over a 10-year period. A 3 or 4-engine operator would experience an estimated net cost savings of $16 million or $11 million over the same time period. A part 135 operator would achieve net cost savings of $8.5 million or $6.0 million, discounted over a 10-year period. The total estimated net cost savings to the industry would be $823.9 million or $530.2 million, discounted.

Costs to existing 2-engine ETOPS operators are estimated at $10.7 million or $7.6 million, discounted over a 10-year period. Additional costs to a new 2-engine ETOPS operator beyond those currently experienced to qualify for ETOPS would total $106,500 or $75,900, discounted. The 10-year costs to a 3 or 4-engine operator that elects to conduct beyond 180-minutes ETOPS would be $3.7 million or $2.8 million, discounted. This includes the costs for complying with the basic ETOPS requirements plus the additional costs of ETOPS beyond 180-minutes. A part 135 operator would incur costs of $1 million or $741,000, discounted over a 10-year period to qualify for beyond 180-minutes ETOPS. The manufacturer of an existing 3 or 4-engine airplane for use beyond 180-minutes ETOPS would incur costs of $4.0 million or $3.3 million, discounted. A business airplane manufacturer would incur total ETOPS costs of $20.6 million or $18.5 million, discounted. Some of this cost could be offset if the applicant is seeking certification of a new type design engine since two required tests could be conducted on the same engine instead of requiring a separate engine for each test. The total estimated cost to the industry would be$265.3 million or $217.7 million, discounted.

The FAA concludes that the proposed rule would preclude and help prevent diversions in remote areas of the world that are beyond 180-minutes from an alternate ETOPS airport. The rule would require all operators to equip their aircraft to minimize the number of diversions and train their personnel to minimize the impact of diversions that do occur.

The proposed rule would not have a significant impact on a substantial number of small entities, nor would it constitute a barrier to international trade. The proposed rule does not contain a federal intergovernmental or private sector mandate that exceeds $100 million in any year, therefore, the requirement of the Unfunded Mandates Reform Act of 1995 do not apply.

BACKGROUND

Since the 1930's, the FAA has restricted the permitted flying times from an adequate airport for part 121 operations. The current rule contained in section 121.161, states that unless authorized by the Administrator, no certificate holder may operate two-engine or three-engine airplanes (except a three-engine turbine powered airplane) over a route that contains a point farther than 1 hour flying time (in still air at normal cruising speed with one engine inoperative) from an adequate airport. However, since 1985 the FAA has authorized operators to fly two-engine aircraft over routes with points more than 1 hour from an adequate airport through a deviation to the rule. These deviations for Extended Twin-engine OPerations (ETOPS) have been granted through the provisions of the carrier's operations specifications. The authorizations have been guided by Advisory Circular (AC) 120-42 and various policy letters.

The AC was originally issued in June 1985 and re-issued as AC120-42A in December 1988. Specific criteria are included for deviation of 75 minutes, 120 minutes, or 180 minutes from an adequate airport. The original AC included a provision that the FAA would allow an operator on a 'case-by-case' basis up to a 15 percent increase over the 120-minute maximum diversion time or a 138-minute limit. This extension provision was not included in the revised AC but the FAA reinstated the 138-minute diversion limit by a policy letter EPL 95-1 in 1994, designating its use only for North Atlantic ETOPS operations. The FAA has revised the AC several times and each time has published the proposed revision in the Federal Register and issued a revision only after consideration of all the public comments. In 1999, the Air Transport Association requested the FAA to issue a policy letter establishing 207-minute ETOPS for the Boeing 777 airplane. The FAA published the letter and draft proposal in the Federal Register and requested public comment. The FAA issued a policy decision, effective March 2000, establishing conditions for a limited authorization for up to 207-minute ETOPS authorization. While the FAA has maintained a public process in establishing ETOPS criteria, deviations are

not substitutes for rulemaking and the FAA determined that rulemaking should be implemented and industry input should be sought.

The FAA established the Aviation Rulemaking Advisory Committee ETOPS Working Group (65FR37447) on June 14, 2000 and tasked the Working Group (WG) to review AC 120-42, as amended, and the various policy letters, and to develop appropriate safety standards and procedures for extended range operations of airplanes including business jets, regardless of the number of engines. Among the policy letters the WG considered was the guidance for Polar operations issued by the FAA in March 2001 that requires certificate holders conducting polar operations to meet unique equipment, training, communication capabilities, and to develop a passenger recovery plan. The WG was further directed to develop criteria for diversion times beyond 180 minutes.

Part 135 on-demand operations on extended range flights have historically not required special authorization. However, in 1996, the FAA expressed a policy in a letter to the European Joint Aviation Authority that the FAA for many years had a de facto policy of allowing trans-Atlantic and Hawaiian part 135 operations below 180 minutes. Thus the ARAC proposed regulations parallel as closely as possible the requirements for 121 and 135 ETOPS while not requiring the part 121 airport firefighting provision or the in-flight shutdown rate calculation and tracking.

Aircraft engine and airframes must be designed for their missions. Reducing the risks of diversion requires the highest design and manufacturing standards and therefore the inclusion of the airplane certification requirements for ETOPS operations necessitated an examination of part 25 and the assurance of engine reliability required a review of Part 33.

SECTION BY SECTION

Section 1.1 would be amended to include a definition of ETOPS and related concepts: in-flight shutdowns, early ETOPS, ETOPS configuration, maintenance and procedures standard, and ETOPS significant systems.

Section 21.4 would be added requiring type certificate holders seeking early ETOPS approval without service experience to establish a problem tracking system that would prompt identification of those problems that could impact the safety of ETOPS operations and, in addition, require engine and airplane manufacturers to periodically report on the reliability of their twin-engine airplane fleets.

Section 25.857(c)(2) would be amended to require the certified time capability of the aircraft fire suppression system from the Aircraft Flight Manual be provided for ETOPS approval.

Section 25.1535 would be added to the Operating Limitations and Information subpart requiring each applicant seeking ETOPS approval to consider crew workload and operational implications and the crew and passengers physiological needs for the longest diversion time being sought. In addition, the applicant would have to comply with the requirements of a new Appendix L of this part. Appendix L would establish airworthiness requirements for both two engine and more than two engine airplanes. The appendix addresses compliance issues common to all ETOPS airplanes including operating in icing conditions, electric power supply, the most time limiting ETOPS

significant system, propulsion systems, engine condition monitoring procedures, flight test requirements, configuration, maintenance and procedures and the flight manual requirements.

Appendix L sets forth three methods to certify airplanes for ETOPS: the service experience method, the Early ETOPS method and a combined service and Early ETOPS. The service experience method generally requires that the airplane and engine combination for which approval is sought accumulate 250,000 worldwide fleet engine hours and perform a reliability review. The number of hours may be reduced if compensating factors are identified. The requirements of this method are the same for all airplanes. The Early ETOPS method differs somewhat for 2 engine versus 3 or 4-engine applicants but both emphasize testing in lieu of in-service experience. Static tests must be conducted to substantiate the suitability of any new technology to be used by the applicant and to validate the reliability of any auxiliary power units that will be used as a backup in-flight power source. Flight tests would also be required including simulating actual ETOPS operations up to the maximum diversion time sought to demonstrate the reliability of ETOPS significant systems. The combined approval method reduces the 250,000 in-service hours required by the first method provided that certain components of the Early ETOPS methods are included.

Section 33.71(c)(4) would be added to require applicants seeking type design for ETOPS eligible engines to ensure the oil tank design will prevent a hazardous quantity of oil loss due to oil tank cap installation errors.

Adding references to new section 33.200 would amend section 33.90. The new 33.200 would establish eligibility and test requirements for applicants seeking engine type design approval for an engine to be installed in a twin-engine ETOPS airplane lacking the 250,000 world-wide fleet engine hours in-service experience required by Appendix L of part 25. The engine design must address in-service problems that resulted in the loss of thrust control, an in-flight shutdown, or other power loss in other relevant engine-type designs previously approved for the applicant within the past ten years. If adequate service data is not available for the past decade a longer "look back" period may be required. Extensive engine testing would be required including a minimum of 3,000 start-stop cycles, and unbalance and vibration endurances tests. At the conclusion of the in-flight testing, the engine must undergo a calibration test, an on-wing visual inspection, and be completely disassembled and a detailed inspection made to identify wear or stress conditions.

The Instructions for Continued Airworthiness contained in Appendix A of part 33 would be amended by adding a new section detailing the engine condition monitoring procedures to be followed for ETOPS airplanes. The procedures for twin-engine ETOPS airplanes would have to be validated before ETOPS eligibility would be granted.

A number of ETOPS specific definitions would be added to section 121.7. The following terms would be defined: adequate airport, ETOPS dual maintenance, ETOPS alternate, ETOPS area of operations, ETOPS maintenance significant system, ETOPS entry point, ETOPS qualified personnel, maximum diversion time, and one engine inoperative cruise

speed. The ETOPS areas of operation in which the planning, operational and equipage requirements of ETOPS apply are also defined and include: NOPAC, North Pacific, North Pole, and South Pole.

The scope of the public protection provision of 121.97(b)(1)(ii) would be expanded to require the certificate holder to obtain, maintain, and distribute to appropriate personnel current data on the availability of facilities at each airport or in the immediate area sufficient to protect the passengers and crew from the elements and to see to their welfare.

Section 121.99(a) would be amended to clarify that the communications requirements of flag operators includes potential routes and altitudes to alternate airports. Section 121.99(c) would be added to specify the requirements for ETOPS routes. For ETOPS beyond 180 minutes operated by scheduled carriers telephone fidelity quality technology, either voice based or data link would have to be installed or more reliable technology as approved by the Administrator. A new section 121.122 would be added to address the communication requirements for supplemental operations that would be similar to the scheduled operations requirements but would not require telephone fidelity quality for beyond 180 minutes. Existing twin-engine ETOPS airplanes capable of operating beyond 180 minutes are already using satellite-based equipment that provides telephone fidelity quality and some 3or 4-engine operators also have already equipped their aircraft with the same technology. The rule is not intended to require an operator to continually upgrade

existing communication equipment but when new technologies are proven to provide significantly enhanced quality the rule would require their use.

The rescue fire fighting service at ETOPS alternate airports would be set for the dispatch of ETOPS flights in a new section 121.106. For operators with ETOPS approval for up to 180 minutes and for two-engine operators approved for 207 minutes ETOPS the planned ETOPS airport alternates must have the capability specified by ICAO Category 4. For all other ETOPS operations beyond 180 minutes, regardless of the number of engines, the planned ETOPS airport alternates must have the capability specified by ICAO Category 7. A 30-minute response time from the initial diversion notification would be deemed adequate. The FAA and the European Joint Aviation Authority in a 1998 policy statement agreed to these requirements. No United States airports would be affected by this provision.

The contents of the certificate holder's manual required by section 121.135 would be amended to include airplane performance data to support all phases of ETOPS operations and passenger recovery plans for each approved en route alternate airport. There would be costs associated with the passenger recovery requirement for all carriers.

Section 121.161, the historic basis for the ETOPS program, would have section 121.161(a) extensively re-written and a new section 121.161(d) added. Paragraph (a) would be limited to turbine engine airplanes and would differentiate between twin-engine airplanes operating over a route farther than 60 minutes from an adequate airport and

airplanes with more than 2 engines operating 180 minutes from an adequate airport. These ETOPS operations must be authorized in the certificate holder's operations specifications and operated according to the specifications in the holder's approved maintenance and operations programs. Paragraph (d) would limit reciprocating engine airplanes to routes 60 minutes or less from an adequate airport unless authorized by the Administrator. There would be no new costs for twin-engine ETOPS operators but 3-4 engine operators who elect to operate on a route more than 180-minutes from an alternate airport would incur costs.

Section 121.374 would require each ETOPS operator to have an ETOPS maintenance program with eight elements:

- Configuration, maintenance, and procedures,
- Continuous airworthiness maintenance program (CAMP),
- Propulsion system monitoring,
- Engine condition monitoring,
- Oil consumption monitoring,
- APU in-flight start program,
- Maintenance training, and
- Procedural changes approval.

The most detailed element is the CAMP program that sets forth eight subparts, some multi-tasked, including an ETOPS pre-departure service check requirement and the development of a reliability program that includes, in addition to the existing reporting requirements of 121.703, six types of events that must be reported within 72 hours.

Crewmembers and dispatchers would be required to receive ground training in their roles and responsibilities in the certificate holder's passenger recovery plan by an amendment to 121.415(a). Cross-polar operators are currently required to provide this training regardless of the number of engines on the airplane. Non-polar operators would incur training costs.

The wording of the requirement to land and report "whenever an engine is *stopped* to prevent possible damage" contained in existing 121.565(a)(4) would be changed to "whenever an engine is *shut down* to prevent possible damage". This change would bring this section into conformity with the in-flight shut down rate requirements and clarifies the existing requirement.

A new section 121.624 - ETOPS Alternates would be added. This section would prevent the dispatch or flight release of an airplane for an ETOPS operation unless the ETOPS alternate airports listed are located such that the airplane remains within the ETOPS maximum diversion time planned for that flight. No airport may be listed as an ETOPS alternate unless the appropriate weather reports or forecasts or any combination thereof are within the ETOPS alternate minima in the certificate holder's operations specifications and with field condition reports indicating that a safe landing can be made. This is an existing ETOPS planning requirement but the proposed rule would require some additional flight planning for weather minima by 3 or 4-engine operators

that elect to go beyond 180-minutes. Section 121.625 would be amended to note the exception for ETOPS alternates.

Section 121.631 would be amended by adding a new paragraph (c) to require the weather conditions at the ETOPS alternates specified in the flight plan to be at or above the airport's operating minimums before a flight continues beyond the ETOPS entry point. A new paragraph (d) would require the pilot in command of a supplemental operation, or the dispatcher for a flag operation, to use company communications to update any revised flight plan if required by a re-evaluation of aircraft system capabilities.

Section 121.633 would be added to set limits on the time permitted to fly the distance to the planned ETOPS alternate airport. For ETOPS of 180 minutes or less, the time limit is calculated by dividing the distance to be flown by the speed of the aircraft. The speed of the aircraft is the approved one engine inoperative cruise speed, in still air and standard day temperature. The resulting time is then compared to the airplane's most time limited system specified in the Airplane Flight Manual minus 15 minutes. The diversion time may not exceed this limit. The maximum diversion time for ETOPS flights planned beyond 180 minutes is calculated differently than for ETOPS flights of less than 180-minutes. The calculation for two engine ETOPS uses the one engine inoperative speed and the time allowed may not exceed the time specified for the airplane's most time limited system time other than the cargo fire suppression system minus 15 minutes. The calculation for three and four engine turbine powered airplanes

is based on the all engine operating cruise speed and the maximum diversion time may not exceed the airplane's cargo suppression time minus 15 minutes. Operators of 3 and 4 engine airplane's not meeting this requirement may continue ETOPS operations for up to 6 years from the effective date of this proposed regulation. These operators would incur costs to retrofit their cargo fire suppression systems.

A new section 121.646 would be added to establish minimum fuel requirements for ETOPS operations by flag or supplemental certificate holders. Factors that must be considered include wind, other weather conditions including icing, a rapid decompression requiring a descent to a safe altitude in compliance with the oxygen supply requirements, varying engine conditions and APU operation. Also included are requirements to hold for 15 minutes at 1500 feet above field elevation before landing and in some cases, the calculation requires a 5 percent fuel reserve to allow for errors. This is a current ETOPS requirement but would require 3 or 4-engine operators to comply with this proposed provision.

Information on the ETOPS time basis (if any) would be required for flag or supplemental operations in the dispatch or release forms by modifying sections 121.687 and 121.689. This information is already available and thus no cost would be incurred.

Appendix O would be added to part 121 setting forth the requirements and limitations for ETOPS approval for various areas of operation and diversion time limits. The aircraft and engine approval process, communication systems, other equipment

requirements, operating procedures, and maintenance programs have higher standards the longer the diversion duration time sought by the applicant and the intended area of operations.

Section 135.98 would be added to set forth specifications for Polar operations. The certificate holder's operation specifications would address key components for safe Polar flights including training, communications capability, MEL considerations and passenger recovery plans.

The pilot training requirements of section 135.345 would be amended to require ETOPS-specific training and ETOPS passenger recovery procedures for ETOPS operations.

Section 135.364 would be added to limit operations outside the Continental United States to within 180 minutes of an airport meeting prescribed standards unless the certificate holder complies with the requirements of new Appendix G.

A certificate holder conducting ETOPS operations would be required to comply with the maintenance program prescribed for aircraft type certificated for ten or more seat by an amendment to section 135.411 and the requirements of Appendix G.

Appendix H would be added to part 135. It would define ETOPS extended operations as flights beyond 180 minutes but planned to remain within 240 minutes of a qualified

airport. It would also add a definition of ETOPS dual maintenance. The appendix also sets forth the experience required to conduct ETOPS operations and places additional requirements on the certificate holder to ensure flight crews have in-flight access to current weather and operational information for each ETOPS flight. For 8 years after the rule is adopted, ETOPS flights would only be allowed to operate by aircraft acceptable to the FAA and meeting certain electrical and fuel systems capabilities. After 8 years a certificate holder could only add aircraft certified to the standards of section 25.1535 to its operations specifications for ETOPS flights. The appendix includes weather minimums, duration limits tied to the cargo fire suppression time or the most time limited system other than the cargo fire system, communication requirements, fuel planning standards, and a maintenance program requirement that mirrors the part 121 ETOPS program.

COST SAVINGS

The ability to fly the most direct route between two points results in time and fuel savings and thus reduces operating costs. The mileage savings for a two-engine ETOPS flight can be very significant. For example, a two-engine operator approved for 180 minutes flying the Great Circle Route, the shortest distance between two points on the earth, between Milan, Italy and Barbados would save over 1,300 nautical miles compared to a routing staying within 60 minutes of an adequate airport.

Part 121 operators of two-engine airplanes will elect to incur the costs associated with the higher ETOPS requirements based on their judgment of whether cost savings would

exceed the cost of compliance. A new 2-engine ETOPS operator operating a single daily roundtrip is estimated to save 38 minutes per round trip. This timesaving is based on the reported timesaving of a current twin-engine Part 121 ETOPS operator operating a route beyond 180-minutes. The operator reported that operating beyond 180-minutes saved 27 minutes on a westbound trans-Pacific flight and 11 minutes on the return leg. The annual hours saved would total approximately 231 hours based on a single daily roundtrip. The total annual savings based on hourly operating costs of $4,500 would be $1,040,000; the ten-year savings would be $10.4 million or $7.3 million, discounted. The costs of the proposed rule to this operator are estimated in the Cost section at $106,500 or $75,900, discounted. This operator would have net cost savings of $10.3 million or $7.2 million, discounted over a 10-year period.

Part 121 operators of three or four-engine airplanes would be required to make a similar judgment if they elect to fly beyond 180-minutes ETOPS. However, the net cost savings would take longer to achieve than if the rule had not been proposed since there are proposed costs that are not currently required for three or four-engine airplanes to fly beyond 180-minutes. A Part 121 operator of a three or four-engine fleet serving a single route beyond 180-minutes assuming the same time savings of 38 minutes per round trip and a single daily roundtrip would have total annual savings of $1,965,000 based on an hourly operating costs of $8,500. The ten-year savings would be $19.7 million or $13.8 million, discounted. The costs of the proposed rule to this operator are estimated in the Cost section at $3.7 million or $2.8 million, discounted. This operator would have net cost savings of $16 million or $11 million, discounted over a 10-year period.

Part 135 operators currently are not permitted to operate beyond 180-minutes from an airport meeting minimum requirements but the proposed rule would allow these operators to do so. Those that elect to incur the costs associated with the proposed rule would experience cost savings attributable to the proposed rule. The timesaving varies by route, airplane speed, and prevailing winds. A Part 135 operator with less fuel capacity would be able to avoid a fuel stop in each direction, which would result in significant timesaving. The FAA estimates that a Part 135 operator would save 2 hours of flying time per round trip by operating beyond 180-minutes. A Part 135 operator with a fleet of four airplanes, with each airplane operating 12 roundtrips beyond 180-minutes ETOPS per year would save 96 hours annually or 960 hours over a 10-year period. The cost savings associated with the timesaving would total $9.6 million or $6.7 million, discounted. The costs of the proposed rule to this operator are estimated in the Cost section at $1.0 million or $741,000, discounted. This operator would experience net cost savings of $8.5 million or $6.0 million, discounted over a 10-year period based on an airplane operating cost of $10,000 per hour.

The net cost savings to individual operators are summarized in Table 1.

Table 1-Net Ten-Year Cost Savings to Individual New ETOPS Operators

	New 2-Engine Operator	3 or 4-Engine Operator	Part 135 Operator
Total Cost savings	$10,395,000	$19,650,000	$9,600,000
Total Cost	$ 106,500	$ 3,676,100	$1,030,400
Net Cost Savings	$10,288,500	$15,973,900	$8,569,600
Present Cost savings	$7,300,400	$13,800,200	$6,742,100
Present Cost	$ 75,900	$ 2,789,200	$ 741,100
Net Present Cost Savings	$7,224,500	$11,011,000	$6,001,000

An applicant seeking certification of a new type engine (as opposed to an applicant seeking a type certificate through an amendment of an existing type certificate or through supplemental type certificate procedures) for ETOPS eligibility would realize cost savings under proposed 33.200(f). Proposed 33.200(f) would allow the applicant to interrupt the 3000 cycle engine test required by 33.200(c) to show compliance with the existing initial maintenance inspection (IMI) test and inspection required by sections 33.90(a-b). The applicant would then resume the ETOPS test to complete the requirements of section 33.200. Thus the applicant for a new type design engine would only have to provide one engine to complete the existing IMI test and inspection and the 3,000-cycle test of the proposed section 33.200(f) rather than 2 engines. The 3,000-cycle test is estimated in the Cost section to cost $6.5 million or $6.1 million, discounted. The FAA requests comments and data addressing this issue.

Manufacturers of business airplanes do not have direct offsetting cost savings. These manufacturers would only voluntarily incur these costs after making a business decision that they could recoup their costs by the sale of airplanes capable of operating beyond 180-minutes ETOPS. The substantial net cost savings that could be achieved by a part 135 operator operating beyond 180-minutes ETOPS would aid the market demand for such airplanes by business airplane operators.

The total cost savings to operators are estimated at $1.09 billion over a ten-year period or $762.3 million, discounted as shown in Table 1A. These savings are based on the following assumptions:

- There are currently 3 2-engine operators flying beyond 180 minutes on an exception basis. It is assumed they will routinely fly 231 hours each beyond 180 minutes.
- There are currently 7 "low cost" passenger carriers (AirTran, America West, ATA, Frontier, JetBlue, Southwest, and Spirit as defined by the Aviation Daily). It is assumed each would operate 4 ETOPS airplanes on a single route.
- There are currently 13 U.S. operators of 3-or 4-engine aircraft and it is assumed each would operate 1 route beyond 180 minutes.
- There are 81 Part 135 operators that both meet the proposed aircraft and maintenance requirements and each would save 96 hours annually.

Table 1A Ten-Year Cost Savings to Operators

Cost-savings to:	Cost Savings	Present Value
3 Existing 2-engine Operators	$31,185,000	$21,901,225
7 New 2-engine Operators	$72,054,500	$50,596,140
13 3-or4-engine Operators	$207,660,700	$143,142,935
81 Part 135 Operators	$777,600,000	$546,108,480
Total Cost Savings	$1,089,210,700	$762,255,500

The net cost-savings to the industry are reduced by the costs incurred by the operators and manufacturers. These costs are addressed in the Cost section in Table 12A. These costs are estimated to be less than the estimated savings and the net cost-savings to the industry are estimated at $823.9 million or $530.2 million, discounted as shown in Table 1B.

Table 1B Ten-Year Net Cost-Savings or Costs to Industry

Category	Cost Savings or Cost	Present Value
Existing 2-engine Operators	$20,449,500	$14,341,826
7 New 2-engine Operators	$72,019,500	$50,571,560
13 3-or4-engine Operators	$159,866,200	$106,879,435
81 Part 135 Operators	$694,137,600	$486,079,380
Reporting and Certification Costs for 3 models of 3 or 4 engine airplanes	($11,875,500)	($9,797,100)
5 Business Aircraft Manufacturers	($36,065,000)	($33,720,900)

Part 25 costs		
5 Business Aircraft Manufacturers		
Part 33 Costs	($50,625,000)	($47,337,500)
Current Part 135 Operators		
Aircraft Replacement Costs	($24,000,000)	($22,440,000)
Total Net Cost Savings	$823,907,300	$530,234,875

In addition to cost savings to operators there are other benefits of the proposed rule.

BENEFITS

Accidents due to diversions are non-existent for twin-engine aircraft operating under parts 121 or 135 and for more than two engine aircraft operating under part 121[1]. The FAA believes the proposed weather provisions of the rule would reduce the probability of an accident occurring and the provision requiring rescue fire fighting services at ETOPS alternate airports would minimize the impact if an accident were to occur. In addition, the FAA believes the proposed requirements to require certificate holders to develop and

[1] The preamble notes that based on the last sixteen years of ETOPS operations with well over 2.5 million ETOPS flights around the world, there is no record of a single incident where a twin on an ETOPS phase of flight with a mechanical event diverted to an ETOPS alternate and the landing resulted in an unanticipated accident. The preamble further states "airplanes with more than two engines have operated safely and successfully on long range routes in all areas of the world for many decades. Research conducted for NBAA in 2000 revealed that during the period 1964 to 1999 there have never been an accident associated with long-range operation of an twin-engine airplane operating in accordance with 14 CFR Part 135. Boeing's ETOPS Quarterly Report for the third quarter 2002 dated January 8, 2003 reported 83 diversions by the world fleet of 777s of which 4 occurred in the ETOPS flight phase for the 12-month period ending September 30, 2002. A diversion was experienced on 0.0008 % of 777 flights. From June 1995 through September 2002, the 777- fleet experienced a total of 341 diversions of which 69 occurred in the ETOPS flight phase. Information provided by Boeing shows that for the year 2002, there were a total of 23 diversions on 747-400 for all technical/mechanical causes. Other Boeing data shows there were 29 propulsion-related diversions per million departures by 747 airplanes from July 1999 through June 2000.

implement passenger recovery plans for ETOPS alternate airports would better protect passengers and crew if a diversion is made for any reason.

Benefits cannot be assigned to specific provisions of the proposed rule; rather, it is assumed that the proposed revisions would work together to prevent diversions and to reduce the impact of any diversions that do occur. Aviation routes not supported within 180-minute diversion authority tend to be routes over remote areas of the world that are uniquely challenging. The additional operational challenges of these routes are equally demanding of all airplanes, regardless of the number of engines, and require all operators to equip their aircraft and train their personnel to prevent diversions and to minimize the impact of diversions that do occur. All operators must support any diversion that occurs and the subsequent recovery by providing the added planning, training and expertise demanded by the event. The FAA believes the requirements of the proposed rule provide the support and procedures necessary to minimize the stress on the airplane, crew, and passengers inherent in a diversion experience.

The FAA believes that the proposed ETOPS requirements would increase the system reliability of an operator that decides to conduct ETOPS operations and thus costly diversions could be reduced. One study that only addressed the cost of an “irregular” operation, unrelated to an ETOPS-type diversion, estimated the cost of a single diversion of a wide-body international flight with passengers having an overnight stay at another

airport at between $89,400 and $181,800[2]. The estimate is based on 200 passengers and 400 passengers and includes allowance for hotel, meals and telephone, aircraft operating costs, lost opportunity cost, and revenue lost from the diverted flight to passengers switching to another carrier. Omitting the opportunity cost would reduce these estimates by $10,000 resulting in a minimum cost of approximately $79,000. The cost of a diversion to a remote site would incur significant costs since recovery times as long as 48 hours are anticipated and per passenger costs may exceed the estimate included in the study. A worst-case scenario presented by Airbus in a CD labeled LROPS involves an engine loss and diversion to an airport in Siberia. Airbus estimated the recovery costs could be as high as $1million including passenger accommodations, chartering an airplane to ferry the passengers to their destination, chartering an airplane to ferry a replacement engine, ferrying the repaired airplane to its station, and loss of airplane use. The FAA requests comments on the number of diversions that might be avoided on flights beyond 180-minutes as a result of the proposed rule and seeks diversion cost data.

COSTS

Compliance with the proposed ETOPS guidelines is a voluntary action by all parties. In the absence of this proposed rule, the FAA would continue the ETOPS program using the existing guidance and policy materials as the basis for granting a deviation to 2-engine part 121 operators. The FAA therefore believes that only costs above those currently incurred by existing ETOPS operators or any new 2-engine ETOPS applicant are costs of the proposed rule. Three or four engine operators and part 135 operators would incur

[2] "Improving Airline Profitability Through Better Estimated Times of Arrival and Terminal Area Flight Information: a Benefit Analysis of PASSUR" Darryl Jenkins and Bill Cotton. Available at www.passur.com/report

costs voluntarily only if they decided that the marginal benefits of flying beyond 180-minutes outweighed the marginal costs. These are not costs of the rule but are provided since the technology exists to conduct such operations.

Assumptions

Given the variety of compensation rates in the industry, the FAA has used the hourly mean wage estimates for various occupations contained in the U.S. Department of Labor, Bureau of Labor Statistics, 2001 National Industry-Specific Occupational Employment and Wage Estimates for SIC 45-Transportation By Air and SIC 372-Aircraft and Parts as the basis for its cost estimates. These wage rates were then adjusted to account for fringe benefits to arrive at hourly compensation rates. These compensation rates were then further adjusted by 75 percent to include the supervisory, administrative, and other support costs associated with the function[3]. These overhead hours are not otherwise included in the estimated hours to accomplish the various cost-related estimates. The FAA recognizes that there may be substantial variations around the costs estimates contained in this document and requests comments with supporting data to refine these estimates. Costs are in 2003 dollars and are discounted at 7 percent.

[3] A 75% markup is conservative. A review of FAA records found additions of 32.40% for fringe benefits, 75.5% for overheads to direct + fringe, and 26% for other fees. The Final Regulatory Evaluation "Transport Airplane Fuel Tank System Design Review" APO-320, January 2001 used an engineer rate of $110. The Dept. of Labor report for SIC 372- Aircraft and Parts indicates that Aerospace Engineers (17-2011) earn a mean hourly wage of $33.97. $33.97x 1.2345% (fringe) =$41.94 x 1.75 (overhead) =$73.40 vs. $110. Another example; Pratt & Whitney charges $120 per hour for ETOPS technical services. The Dept. of Labor report for SIC 372- Aircraft and Parts indicates that Aerospace Engineering & Operations Technicians (17-3021) earn a mean hourly wage of $27.11. $27.11 x 1.2345% (fringe) =$33.47 x 1.75 (overhead) =$58.57. This is significantly less than the stated charge. This is for illustrative purposes only and no inferences should be drawn.

The estimated costs of the proposed rule will vary depending on the status of the certificate holder and the engine and airframe manufacturers.

The ETOPS deviation process for twin-engine operations has been in practice since 1985 and subsequent changes to the guiding advisory circular and FAA policy letters have been widely discussed. The existing guidance addresses the standards engine and airframe manufacturers and part 121 certificate holders operating two-engine aircraft must meet to obtain a deviation from Section 121.161. There are twelve active U.S. carriers currently authorized to conduct ETOPS operations, all but one having 180 minutes approvals and three with 207 minutes approvals[4]. Worldwide, Boeing reported 94 current ETOPS operators and more than 2.6 million cumulative ETOPS flights flown through September 2002. This regulatory evaluation only addresses the costs and benefits to U.S. certificate holders, and U.S. engine and airframe manufacturers.

Part 121 certificate holders operating 3 or 4-engine aircraft that voluntarily seek to operate a route more than 180 minutes from an adequate airport or an area designated by the FAA as an area of ETOPS applicability would have to comply with certain provisions that would create costs. The ARAC believes long, thin routes such as between South America and Australia/New Zealand, South Africa to Australia, and the tip of South America to South Africa would be subject to the beyond 180-minutes requirements. The ARAC was unaware of any U.S. airlines operating airplanes with more than two engines serving these routes on a scheduled basis. A direct routing between Los Angeles and

[4] DOT lists 130 active U.S. certificated air carriers as of March 25, 2003, thus only 10% of all certificated carriers are approved for ETOPS after 17 years of availability.

New Zealand would subject some operators on B747-200s and DC10/MD11 to the beyond 180-minutes requirements depending on the speed used and the total diversion time. The FAA is unaware of any scheduled US airline operating these aircraft on that route.

The FAA already requires all carriers conducting polar operations, regardless of the number of engines, to meet equipment and airplane configuration requirements and to develop passenger recovery plans. Designated airports must be capable of providing for the physiological needs of the passengers and crew. Crews must be trained on weather patterns and aircraft system limitations, use of cold weather equipment, and fuel freeze. Carriers must supply cold weather gear and validate all the requirements.

The decision to operate beyond 180-minutes is voluntary. However, the FAA does consider the costs that would be incurred since these would be new requirements. The costs to a particular carrier may differ from the estimates contained in this regulatory evaluation since AC 120-42A notes, "many of the criteria in this AC may be currently incorporated into an operator's approved program for other airplanes or route structures".[5] The ARAC confirmed this conclusion in its report. Back Aviation data as of March 2003 indicates that there are three part 121 carriers conducting passenger operations on 3 or 4 engine airplanes, six part 121 carriers providing all-cargo services on 3 or 4 engine airplanes, and four carriers operating both passenger and cargo airplanes. The active part 121-fleet of 3 or 4 engine airplanes totaled 354 planes of which 131 were passenger planes and 223 were cargo. One all-passenger operator has indicated it will

[5] Page 4, Applicability, AC 120-42A.

phase out the 15 3-engine aircraft in its fleet by 2004 that will reduce the total to 339 and the number of passenger planes to 116. All-cargo operators operated 149 of the cargo aircraft. There are options to purchase 2 passenger airplanes and 1 order and options to purchase 4 cargo airplanes thus raising the total to 346 assuming all options are realized of which 118 would be passenger planes and 228 would be all-cargo planes. Costs of the proposed rule would vary for different type operators if they voluntarily elect to operate beyond 180 minutes. The FAA requests 3 or 4 engine operators to comment as to whether their strategic plan includes routes beyond 180 minutes and whether they would upgrade their entire fleet or just a portion.

The proposed rule would impose costs on Part 135 operations that voluntarily seek to operate a route outside the Continental United States unless the planned route remains within 180 minutes flying time from an airport that meets various requirements. As noted in the Background section, the FAA has maintained a defacto policy over the years that limits Part 135 operations to within 180 minutes of an adequate alternate airport. The FAA has for many years allowed part 135 operations from the United States to Europe and in the Pacific from the continental U.S. to Hawaii, all within 180 minutes. While the statement of this policy was widely noted in the 135 community, the FAA has never issued an AC relating to these part 135 operations or provided opportunity for public comment. Thus, the FAA believes that any costs imposed by the proposed rule on current operations are costs of the proposed rule but that costs imposed on future part 135 operations beyond 180-minutes are voluntary.

Additional Costs to Two Engine ETOPS Operators of Proposed ETOPS Regulation

Passenger Recovery Plans

The costs related to the expanded discussion of the concept of what constitutes "public protection" which is being added to section 121.97(b)(1)(ii) would be imposed by the implementation of an amendment to section 121.135(b) that would require all certificate holders to prepare passenger recovery plans applicable to each ETOPS alternate airport listed in the carrier's operations specifications. Currently passenger recovery plans are required only for cross-polar operations. Thus, cross-polar ETOPS operators would have to prepare passenger recovery plans for areas outside the polar area and other ETOPS operators would have to prepare plans for each ETOPS area they serve and must demonstrate that the regional plan is robust enough to handle a diversion to any listed alternate airport within that region.

The cost and complexity of preparing the regional passenger recovery plans will vary by the areas of ETOPS operations and the number of alternate airports listed within each region. In the North Atlantic region, for example, the Civil Aviation Administration of Iceland airport handbook provides general information for both on and off airport hotel and restaurant accommodations, availability of local transportation and medical facilities that would help minimize the preparation of a North Atlantic plan that lists Reykjavik Airport as an alternate. In addition, a carrier with a number of routes over the North Atlantic will have sufficient resources within the region to provide prompt logistical support to the diversion aircraft. The development of a plan would require the cooperative efforts of staff from Flight Operations, Maintenance, Command Center, and

other support services. Information provided by a current polar operator that is already required to have a passenger recovery plan estimates that the initial plan required approximately 100 staff hours.

Based on this information and discussions during the ARAC process that, although not required by the AC, many carriers already have an internal recovery plan for all areas of operation, the FAA estimates that initial regional plans that would meet the proposed requirement would require approximately 100 staff hours. The FAA estimates that 40 staff hours would be required annually to maintain the robustness of each plan. The total cost of the initial preparation of these regional plans and annual updates by existing ETOPS operators for current areas of ETOPS operations is estimated at $655,500, or $480,250 discounted using an hourly cost of $75. See Appendix Table A-1. The FAA cannot estimate how many, if any, current ETOPS operators may pursue routes in new areas that would require the preparation of a new regional plan. The total cost to a new two-engine ETOPS operator, assuming entry to one area would result in total costs of $34,500 or $25,300, discounted.

Section 121.415(a)(4) would require crewmembers and dispatchers to receive training on their role in the certificate holder's passenger recovery plan. Most of the implementation of the recovery plan would reside in the special operations command center and thus the training crewmembers and dispatchers would be limited to their specific role. Crewmembers and dispatchers are already required to have ETOPS training under current policy. The FAA believes that the dispatcher passenger recovery training would be

incorporated into existing ETOPS training modules and through the circulation of computer-based or printed materials. The current recommended areas of training include 14 specific topics and the addition of the recovery plan could be accommodated within the existing training time. Similarly, already required flight crew ETOPS training sessions generally are one to two days in length and the recovery plan would be incorporated within the existing training time. The FAA believes that there would be only minimal costs to comply with this proposed provision. The FAA requests comments and data regarding this conclusion.

Maintenance Issues

Proposed section 121.374(b)(8)(ii) would require certificate holders to conduct an investigation into the cause of any event listed in section 121.703 or on specific conditions listed in the existing AC and incorporated into the proposed rule in section 121.374(a). Section 121.703 currently requires certificate holders to file mechanical reliability reports concerning the failure, malfunction, or defect concerning seventeen distinct conditions such as fires during flight, engine shutdowns, landing-gear events and braking conditions. The FAA does not believe these current practices are sufficient and has added the requirement to investigate the cause of such occurrences and submit findings and descriptive corrective actions acceptable to the FAA. The FAA believes that there is about a 5 percent incident rate per ETOPS airplane that would require an investigation. The FAA further believes that the staff hours required to investigate and implement the corrective action ranges could range from a few hours to perhaps a 1,000

hours as a "worst case" scenario but that the vast majority of incidents could be investigated and resolved within two staff-days. The 10-year cost of this provision to current ETOPS operators is estimated at $10.1 million or $7.1 million, discounted based on an hourly cost of $45. See Appendix Table A-2. The total cost to a new two-engine ETOPS operator, assuming a fleet of 4 airplanes, is estimated at $72,000 or $50,600, discounted.

Summary of Costs to Existing and New Two-Engine ETOPS Operators

The total cost of the provisions of the proposed rule for existing two-engine ETOPS operators over a ten-year period beyond those incurred to comply with the existing policy and guidance is estimated at $10.7 million or $7.6 million, discounted as show in Table 2.

Table 2
Estimated Ten-Year Cost of Proposed Rule
To Existing Two-Engine ETOPS Operators

Cost Area	Total Cost	Present Value
Recovery Plan	$ 655,500	$ 480,250
Additionnel Maintenance Investigation	$10,080,000	$7,079,200
Total	$10,735,500	$7,559,450

The cost to a new entrant 2-engine ETOPS operator beyond the cost of the current guidance and policies would be approximately $106,500 or $75,900, discounted. This reflects the cost of one recovery plan and maintenance investigation and resolution costs for a four-airplane ETOPS operation.

Costs to 3 or 4 engine Operators of Proposed ETOPS Regulation

The certificate holders that will be operating the 346 aircraft with 3 or 4 engines by 2004 will independently decide whether to serve the long, thin routes that will entail routes beyond 180-minutes of an adequate airport. One large operator has indicated it is unlikely to do so but would rather serve these markets with its existing ETOPS fleet. Operators with only a few of these airplanes may also decide not to enter these markets.

Given the uncertainty of the market, the FAA makes the following assumptions to estimate the annual costs voluntarily assumed by a single carrier:

- ETOPS beyond 180-minutes would be operated on a single route,
- Four airplanes would be required to support this route on an annual basis,
- Flight crew roster would include 1 Captain, 4 First Officers, and 10 Flight Attendants per airplane,
- Maintenance support for the operation would require 20 inspectors and mechanics.

The proposed rule would require both capital and operating costs to be assumed by the operator. The capital costs relate to the communication technology and the cargo fire suppression system on airplanes operating beyond 180-minutes.

Communication Systems

Section 121.99(d) would be added to require additional voice communication equipment for all ETOPS operations beyond 180-minutes to assure reliable and rapid two-way communications over the entire route by scheduled carriers and a new section 121.122

would impose the same requirement on supplemental carriers. The equipment installed must be capable of providing telephone-fidelity communication technology as approved by the FAA. The interpretation of what constitutes "telephone-fidelity" at the current state of technology is generally considered satellite based systems (SATCOM). These systems are installed on some B747-400s used in Polar operations and two large all-cargo operators reportedly have installed SATCOM systems on at least part of their 3 and 4-engine fleets. The systems are available through a number of manufacturers. The proposed rule does not reference SATCOM as a required system. It is assumed, for this analysis, that satellite-based systems would be used to meet the new communication requirement. The proposed rule also does not provide any timeframe for the installation of such equipment but for estimating purposes a two-year phase-in period was used. The total cost of this proposed improved technology for four airplanes is estimated at $892,000 or $806,400, discounted. The modification would be performed when the aircraft is out of service for other scheduled maintenance. See Appendix Table A-3.

The installation of this equipment would add weight to the aircraft and result in greater fuel consumption. The FAA estimates the total fuel cost over the ten-year period would be $18,900 or $13,000, discounted. See Appendix Table A-4.

In addition to the installation costs there are operating costs associated with the systems. The operating costs consist of a monthly fixed fee and a variable usage charge. The operating costs may be at least offset, if not already a source of net revenues, on passenger aircraft by revenues earned from passengers using the equipment for in-seat

phones voice, fax or Internet services. All carriers can benefit by the real-time fleet management made possible by the installation of these telephone-fidelity systems that can automatically monitor and provide maintenance information, and calculate optimal engine settings. The FAA estimates the additional fixed operating cost for 4 systems over the ten-year period would be $76,000 or $52, 400, discounted. See Appendix Table A-5. The FAA assumes either passenger revenues or improved maintenance procedures would offset the variable costs.

The total cost of upgrading the communication systems of the 4 aircraft required to serve a single beyond 180-minute route is estimated at $987,000 or $872,000, discounted as shown in Table 3.

Table 3 –Installation and Related Operating Costs of Telephone-Fidelity Communication System

Cost Area	Total Cost	Present Value
Installation	$892,000	$806,400
Fuel Expenses	$18,900	$13,000
Fixed Operating Costs	$76,000	$52,400
Total Cost	$986,900	$871,800

Cargo Fire Suppression Systems

The requirements for ETOPS up to and including 180-minutes would be unchanged. Section 121.633(b) would require that the flight plan for ETOPS beyond 180-minutes be calculated as the time required to fly the distance to the planned ETOPS alternate(s) at the all engines operating cruise speed, correcting for wind and temperature. The resulting time may not exceed the time specified in the Airplane Flight Manual for the airplane's cargo fire suppression minus 15 minutes. Section 121.633(d) would permit 3 and 4

engine turbine powered airplanes not meeting this requirement a period not to exceed 6 years from the date of this regulation to meet the requirement.

The FAA believes that most existing 3 or 4 engine airplanes would not meet this requirement and would have to upgrade their cargo fire suppression systems. Most 747-400s already have 195-minute bottles containing the fire suppressant, Halon, and depending on the route network may not need to be modified while other airplanes may need more than one bottle. The FAA estimates that the cost of the kit needed to upgrade the system would be $65,000 and would require 32 hours to install at $45 per hour for a total of $1,400. In addition, another Halon bottle would be required at an estimated cost of $10,000. The total cost per modification is estimated at $76,400. The modification would be performed when the aircraft is out of service for other scheduled maintenance. The total modification cost for a fleet of 4 airplanes is estimated at $305,800 or $211,400, discounted. The discounted cost assumes the modifications would be completed at a rate of one airplane per year. See Appendix Table A-6.

The modifications would add weight to the aircraft and result in greater fuel consumption. The FAA estimates the total fuel cost for 4 airplanes over the ten-year period would be $105,500 or $63,300, discounted.[6] See Appendix Table A-7.

[6] This is based on a per gallon cost of 77 cents. This is the average Spot Price of Jet Fuel at the New York Harbor for the period 1/02-4/03as reported by the US Energy Information Administration. Cost estimated on engine configuration, hourly additional fuel burn and estimated annual hours flown by model and phase-in over four years.

The total cost of upgrading the cargo fuel suppression systems to serve a single ETOPS route by a 3 or 4-engine fleet of 4 airplanes is estimated at $411,300 or $274,700, discounted as shown in Table 4.

Table 4 – Total Cost Attributable to Modifying Cargo Fire Suppression Systems

Cost Area	Total Cost	Present Value
Modification Costs	$305,800	$211,400
Fuel Expenses	$105,500	$63,300
Total	$411,300	$274,700

Three and Four Engine Operating Requirements for Beyond 180-minutes ETOPS

Section 121.161 would be amended to require certificate holders operating a route that contains a point farther than 180-minutes flying time from an adequate airport or an Area of ETOPS Applicability to comply with the provisions of new Appendix O. Section B of Appendix O addresses ETOPS authorizations for airplanes with more than 2 engines. For all operations beyond 180-minutes, the nearest ETOPS alternate must be specified. On all such operations the minimum equipment list (MEL) limitations for ETOPS apply and, in addition, the Fuel Quantity Indicating System (FQIS), and the communications system must be operational. Non-ETOPS flights may be flown with certain MEL items and part of the FQIS not operating. However, an ETOPS operation could not be released for flight if any of the listed items are inoperable. For example, there are 4 detection loops installed on a B-757's engine turbine overheat system and except for an ETOPS flight beyond 120 minutes one loop per engine may be inoperative. Correcting this for an ETOPS flight could result in a departure delay or require an equipment substitution. The

FAA does not have a basis for quantifying this cost and requests comments and supporting data to further address this issue.

Section 121.374 would require each certificate holder operating beyond 180-minutes to have an ETOPS maintenance program. This program is in addition to the maintenance program required by 121.367. Although the elements of the ETOPS program are normally part of the operator's basic continuing airworthiness program there may be a need to supplement it in consideration of the special requirements of ETOPS. The development of the ETOPS maintenance program would be a complex task since the program has eighteen components that would have to be addressed. The program includes preparation of manuals, establishing procedures, performing tasks, and conducting training.

A fundamental element of the program is the preparation of the ETOPS program document. This would either be a stand-alone manual, or an added section to an existing manual. There would typically be a Maintenance section and an Operations section although the former would be more extensive. It would reference all the elements including dual maintenance procedures (374(b)(2)), verification procedures (374(b)(3)), referencing central maintenance control organization (374(b)(5)), develop parts control procedures (374(b)(7)), and incorporate procedures for coordinating maintenance and training changes with the FAA (374(h)). Depending on the complexity of the intended operation, the operator's experience and infrastructure this process would take 3 to 6 staff months. While this analysis is presenting the costs of a single route operation, the FAA,

not to underestimate the cost, estimates that the program document would take 3 months to develop and the total cost would be $44,200 at $85 per hour.

Section 121.374(b)(1) would require the certificate holder to develop and write procedures for a pre-departure check. The FAA estimates that this process would take 6 weeks to develop and the cost would total $ 20,400. Section 121.374(b)(4) would require the certificate holder to develop and write procedures for identifying ETOPS specific procedures and the FAA estimates this task could be accomplished in 8 staff hours at a total cost of $700. Section 121.374(b)(8) would require the certificate holder to develop or supplement the existing reliability program. The FAA estimates it would take carriers with an existing program approximately 100 hours to supplement their program. Smaller carriers that do not have an existing program would have to enhance their Continuing Analysis Surveillance System, which would require 200 hours. The total cost for one carrier requiring 200 hours is estimated at $17,000. The total costs of these one-time procedural requirements for one operator are estimated at $82,300 or $77,000, discounted. See Appendix Table A-8.

Section 121.374(a) would establish the baseline configuration standard for each specific airplane and engine combination used in ETOPS by the air carrier. The manufacturer prepares the document and if the aircraft were new there would be no cost. An aircraft currently in use may have to be modified to meet the required configuration. The cost

would vary by aircraft and the FAA has no basis for estimating this cost. The FAA requests comments and supporting data to further address this issue.

Section 121.374(a)(1) would require a pre-departure service check immediately prior to an ETOPS flight. Assuming a daily check of three of the four airplanes serving the route requiring two staff-hours per airplane to complete at a total cost of $180 per check, the ten-year cost of this check would be $985,000 or $692,100, discounted. See Appendix Table A-8-1.

Section 121.374(b)(8)(ii) would require an investigation into the cause of the occurrence of any event listed in section 121.703. Assuming the same occurrence rate of 5 percent used in the cost estimate for 2-engine ETOPS operators, the ten-year cost of this proposed provision for a 4-airplane operation would be $72,000 or $50,600, discounted. The FAA assumes that the equivalent hours of a fully supported mechanic or a cost of $93,600 annually would be required for the reporting and investigation program required by this section as well as the in-flight shutdown (IFSD), engine and oil consumption monitoring requirements of sections 121.374 (c)(1) and (2), 121.374(d) and 121.374(e). The FAA requests comments and supporting data to further address this issue.
The total cost of the on-going requirements of the ETOPS maintenance program for the operator of a 4-airplane fleet over a 10-year period would be $2.0 million or $1.4 million, discounted assuming the addition of a mechanic. See Appendix Table A-9.

Section 121.374(g) would require certificate holders to supplement their existing maintenance-training program to include additional ETOPS specific training. While major operators are likely to have a sufficient number of maintenance personnel with the aircraft and engine technology training required to support the ETOPS program and only require minimum supplemental training, smaller operators would have to provide this training in addition to the ETOPS-specific training. The FAA estimates that the ETOPS specific training would require 4 hours of initial training and 1 hour recurrent training. The aircraft and engine technology training needed to support ETOPS would require 40 hours. The total ten-year cost to one operator for providing 44 hours of initial training and one hour refresher training annually for a workforce of 20 mechanics is estimated at $47,700 or $42,500, discounted. A carrier would not have to train all its mechanics but a number of carriers have decided that all operations have benefited from ETOPS maintenance procedures.

Summary of ETOPS Maintenance Costs Incurred by A Single Route 3 or 4 engine Operator

The FAA has quantified the cost of establishing and conducting an ETOPS maintenance program over a ten-year period on a single route to be $2.1 million or $1.5 million, discounted as shown in Table 5. The FAA has not been able to quantify some of the elements of the program. The FAA requests comments and data on all elements of the proposed maintenance program.

Table 5
Estimated 10-Year Cost of Developing and Conducting an ETOPS Maintenance Program For A Single Route Operated With Four 3 or 4-Engine Airplanes

Area	Total Cost	Present Value

Development of ETOPS Documentation	$ 82,300	$ 77,000
Continuing Costs	$1,993,500	$1,400,000
Training Costs	$ 47,700	$ 42,500
Total Maintenance Cost	$2,123,500	$1,519,500

Section 121.415(a)(4) would require crew and dispatchers to be trained in their roles and responsibilities in the passenger recovery plan. The cost to prepare a recovery plan for a single route would be $34,500 or $25,300, discounted over a ten-year period. See Appendix Table A-10-1. Initial training hours for pilots are estimated at 16 hours, four hours for flight attendants and 12 hours for dispatchers and annual training for all staff at 1 hour. The ten-year cost of the initial and annual ETOPS training for a single operator is estimated at $120,300 or $98,800, discounted. See Appendix Table A-10-2.

Section 121.624 would require 3 or 4-engine operators engaged in ETOPS flights to include each ETOPS alternate airport to be listed in the dispatch or flight release. The listed alternates must indicate that weather conditions are at or above the minima specified in the operations specifications and the field conditions report that a safe landing can be accomplished at the landing time of the flight. Most flight planning is computer-generated, either by the operator or a flight planning service. Some additional data would have to be entered as to the proposed route and the maximum diversion distance. The computer results would then be used by the dispatcher and the pilot to verify that the weather at the ETOPS alternate airports meets the dispatch requirements. The FAA believes the time and cost to make this determination is minimal but the FAA invites comments and data on this conclusion.

Section 121.646 would not permit airplanes with 3 or 4-engines to dispatch or release an ETOPS flight unless, considering wind and other expected weather conditions, it has adequate fuel to fly to an ETOPS alternate assuming a rapid cabin decompression at the approved one engine inoperative cruise speed. Since fuel planning is generally computerized the planning costs would be minimal. However, although many affected operators already voluntarily carry a fuel reserve for cabin depressurization this proposal would require these flights to carry an ETOPS fuel reserve. This would result in added operating costs due to the weight of the fuel but the FAA does not have a basis for estimating the cost since the amount required would be specific to each individual flight plan. The FAA requests comments and supporting data to further address this issue.

The FAA does not believe any of the other proposed provisions would result in additional costs to 3 or 4-engine operators.

Total Costs to A Three or Four-Engine Operator For A Single ETOPS Route

The total voluntary costs of meeting ETOPS-requirements to a single 3 or 4-engine operator flying one route with 4 airplanes beyond 180-minutes from an adequate airport are estimated at $3.7 million for a 10-year period or $2.8 million, discounted as shown in Table 6.

Table 6- Total Ten-Year ETOPS Costs to A 3 or 4-Engine Operator

Cost Area	Total Cost	Present Value
Communication System	$986,900	$ 871,800
Cargo Fire Suppression	$411,300	$ 274,100
Maintenance	$2,123,500	$1,519,500
Recovery Plans	$ 34,500	$ 25,300

Training	$ 120,300	$ 98,800
TOTAL	$3,676,500	$2,789,500

Costs to Part 135 Operators

The decision to operate beyond 180-minute ETOPS flights would be made on the basis of the benefits exceeding the voluntary costs of complying with this proposed rule. The operator would have to review the proposed provisions of this rule in making that determination. The FAA is proposing to add definitions to Part 135, amend four existing sections and add Appendix H. Appendix H would encompass all the elements for conducting ETOPS under part 135 including definitions, required experience, and requirements covering all aspects of ETOPS operations including airplane, certificate holder, operations, communications, fuel planning, and maintenance. Appendix H is subdivided in sections lettered A through H. Section A would define ETOPS and dual maintenance. Section B would require at least 12 months operating experience conducting international operations. While the experience requirement may delay an operator's use of ETOPS and may result in lost opportunity costs, safety demands require this provision.

Section C would set forth minimum aircraft requirements for ETOPS operations. Only multi-engine airplanes would be permitted and during the first eight years after the rule was adopted only aircraft acceptable to the FAA and meeting electrical and fuel system capabilities would be allowed. After eight years certificate holders could only add airplanes certificated to the design and service requirements of part 25.1535. These

requirements include airplane and propulsion systems provisions, flight test requirements, and CMP standards. The potential impact of this provision is discussed in Part 25. The FAA's database indicates that there are currently 300 part 135 operators authorized to conduct international operations. Some 174 of these operators conduct their operations in the Atlantic region while 126 operators are authorized to operate in the Hawaii, Pacific, or North Pacific regions.

The proposed rule would have a direct impact on six operators since the aircraft they currently operate between the West Coast and Hawaii would not meet the electrical and/or the fuel system capabilities of the proposed rule and thus, would be unacceptable to the FAA. It is not feasible to upgrade these aircraft to meet the requirements but these operators could voluntarily substitute an FAA-acceptable airplane at a net cost of approximately $4 million per airplane or a total of $24 million or $22.4 million discounted. A number of other operators that conduct West Coast-Hawaii operations also have unacceptable aircraft in their operations specifications but also operate acceptable aircraft and thus would be able to continue to serve the market. All operators could continue to use the unacceptable aircraft in other markets. The FAA believes this proposed provision would not have a significant impact on these operators' revenues.

The FAA database indicates that 37 operators have aircraft that currently meet the proposed aircraft requirements but do not meet the maintenance provisions of existing section 135.411(a)(2) for aircraft type certificated for 10 or more seats that would be a requirement for operations beyond 180-minutes. The FAA believes these operators

would continue to fly non-ETOPS international routes and therefore would not incur ETOPS-related costs.

Some 81 operators meet both the proposed aircraft and maintenance requirements and operate over 540 aircraft. The range of operations of these 81 operators varies widely in scope, frequency and equipment type. One operator has more than 100 airplanes; some may have several trans-Pacific flights daily while others may have only a few international flights a year. Four of these operators are operating Boeing business jet (BBJ) aircraft that are the equivalent to the 737-400 that currently meets part 121 ETOPS requirements while others operate airplane such as Gulfstream IV and V's. The FAA has no basis for determining how many current 135 operators would elect to conduct ETOPS operations. The FAA requests information from operators regarding their future intentions.

For this analysis the FAA assumes that an operator who elects to conduct ETOPS operations would:

- Have a fleet of 4 airplanes,
- Does not require cargo fire suppression systems
- Have a crew of 4 pilots for each aircraft,
- Operate 1 ETOPS roundtrip per aircraft per month,
- And would require 2 ETOPS certified mechanics.

Section D would require certificate holders operating beyond 180 minutes to remain within 240 minutes of an airport meeting the current provisions of part 135. In addition to the current requirements to provide the flight crew with operating and landing data, the certificate holder would have to ensure the crew had in-flight access to current weather and operational information on all en route alternate, destination and destination alternate airports listed in the flight plan. The aircraft capable of ETOPS are generally equipped with advanced navigation, communications, and weather technology equipment and the FAA does not believe there would be significant compliance costs. The FAA requests comments and data addressing this provision.

Section E would prohibit pilots from passing the ETOPS entry point unless the en route ETOPS alternate airports meet the operating minimums at the expected time of arrival. Section E also would require ETOPS flights to be conducted under instrument flight rules. The FAA does not believe there are costs associated with these provisions. This section would also limit the diversion time to the planned ETOPS alternate airport to the airplane's most time limited system time contained in the Airplane Flight Manual minus 15 minutes. The measurement of the most time limited system time would differ for the cargo fire suppression system, if installed, and the other most time limited system. Aircraft not meeting the resulting requirements could continue ETOPS operations for up to eight years after the rule was adopted. Many of the ETOPS-eligible airplanes do not have cargo holds that require fire suppression systems and thus would not be affected. Boeing BBJ's do have cargo holds that could be affected.

Section F would establish minimum communication requirements for transmitters, receivers and headsets and permit alternative systems when voice communications are not possible. The FAA does not believe there are costs associated with this provision since the aircraft operated by the 81 operators already meet this requirement.

Section G would prohibit a ETOPS flight unless, considering wind and other expected weather conditions, it has sufficient fuel to fly to an ETOPS alternate at the approved one engine inoperative cruise speed assuming a rapid cabin decompression. The flight planning calculation would have to compensate for airframe icing, if forecast. Further, unless the operator has a fuel burn monitoring program established, the operator would have to increase the fuel supply by 5 percent. Since fuel planning is generally computerized the planning costs would be minimal. However, this proposal would require flights to carry an ETOPS fuel reserve. This would result in added operating costs due to the weight of the fuel but the FAA does not have a basis for estimating the cost since the amount required would be specific to each individual flight plan. The FAA requests comments and supporting data to further address this issue.

Section H would establish the ETOPS maintenance requirements. A fundamental element of the program is the preparation of the ETOPS program document ((b)(6)). It would reference all the elements including dual maintenance procedures ((b)(2)), verification procedures ((b)(3)), identify ETOPS tasks ((b)(4)), document central maintenance control ((b)(5)), develop parts control procedures ((b)(7)), and incorporate procedures for coordinating maintenance and training changes with the FAA ((b)(h)). An operator

would likely seek the services of a service company to develop the program. The FAA estimates that the program would cost approximately $5,000.

Section H (a) would establish the baseline configuration standard for each specific airplane and engine combination used in ETOPS. The manufacturer prepares the document and if the aircraft were new there would be no cost. An aircraft currently in use may have to be modified to meet the required configuration. The cost would vary by aircraft and the FAA has no basis for estimating this cost. The FAA requests comments and supporting data to further address this issue.

The certificate holder would be required to follow the continuous maintenance program (CAMP) developed under the provisions of Section H (b). This would require an ETOPS pre-departure check, use of dual maintenance procedures, and the inclusion of the ETOPS program elements into their Continuing Analysis Surveillance System (CASS) program. The FAA estimates that the pre-departure check would require 1 hour for each ETOPS flight and that each aircraft would require 24 inspections per year. The total 10-year cost to the operator would be $43,200 or $30,300, discounted. See Appendix Table A-11. The use of dual maintenance procedures may result in additional cost but many operators have incorporated such provisions voluntarily since the benefits have outweighed the costs. The FAA does not have a basis for determining the cost of this provision. The FAA estimates enhancing the CASS program would require 100 hours and would cost $4,500 or $4,200, discounted. The enhanced CASS program would also require reporting of significant events such as in-flight shutdowns and other engine problems, as well as

any problem with other ETOPS critical systems within 72 hours to the FAA. Operators are already required to report and investigate these types of events to the FAA; the only difference is the reporting time limit imposed. The FAA believes there would only be minimal costs associated with this provision.

The ETOPS maintenance program would also require the certificate holder to establish and perform propulsion system, engine condition and oil consumption monitoring programs (H (8)(c-e)). Elements of these tasks could be accomplished by various automated monitoring systems available while checking oil levels and investigating propulsion system errors require staff. The FAA estimates these tasks would require the full-time equivalent of 1 mechanic at an annual cost of $93,600. The 10-year costs of these provisions are estimated at $930,600 or $ 657,000,discounted.

Section H (g) would require the certificate holder to develop additional ETOPS-specific training. The FAA estimates this would require 4 hours of initial training and 1 hour of annually training for ETOPS-specific issues. The 10-year cost of this training is estimated at $1,200 or $900, discounted. See Appendix Table A-12

Section H (i) would require the certificate holder to report quarterly the operating hours and cycles for each engine and airframe authorized to conduct ETOPS. The FAA estimates it would require 8 hours of a mechanics time annually to provide this information and the 10-year cost of this reporting for a single operator would be $3,600 or $2,500,discounted. See Appendix Table A-13.

The FAA has quantified the cost of establishing and conducting an ETOPS-maintenance program for the illustrative part 135 operator over a ten-year period to be $940,000 or $665,000, discounted as shown in Table 7. The FAA also has not been able to quantify some of the elements of the program. The FAA requests comments and data on all elements of the proposed maintenance program

Table 7 Quantified ETOPS Maintenance Costs per Part 135 Operator

Area	Total Cost	Present Value
ETOPS Documentation	$5,000	$4,700
Monitoring Programs	$930,600	$657,000
Training	$1,200	$900
Reporting	$3,600	$2,500
Total	$940,400	$665,100

In addition to Appendix H, other sections of part 135 would be amended to assure safe ETOPS operations.

Part 135.98 would require an operator seeking to conduct flights in the region north of latitude $N78^0$ to address eight items to receive the authorization. Part 135 operators en route to Asia currently do not fly in the Polar region and would be allowed to continue their current routing. Any operator that elects to operate in the Polar ETOPS area would do so voluntarily. The costs to operate in this region include preparing recovery plans, training crews and equipment capabilities. The 10-year cost of the recovery plan would be $9,800 or $7,400, discounted. See Appendix Table A-14. The recovery plan would include diversion airport requirements. Polar exposure suits are estimated to cost $300 each and it is assumed the operator would maintain a stock of 10 suits for a total cost of

$3,000 or $2,800, discounted. The communication capability of the existing ETOPS-eligible airplanes is believed adequate and MEL considerations would not be a cost issue for these airplanes. Crew training is estimated at $500 per pilot or a total cost of $8,000 or $7,500 discounted. The total costs of conducting polar operations are estimated at $20,800 or $17,700, discounted. See Appendix Table A-15.

Part 135.345 would amend the pilot training requirement to include ETOPS-specific and passenger recovery training. The FAA estimates that initial and annual training would require 16 hours and 1 hour, respectively and that the 10-year cost of this training for 16 pilots would be $69,200 or $58,300, discounted. See Appendix Table A-16.

The total voluntary ETOPS costs to a part 135 operator flying beyond 180-minutes from an adequate airport are estimated at $1.0 million or $741,000, discounted for a 10-year period as shown in Table 8.

Table 8 Ten-Year ETOPS Costs per Part 135 Operator Assuming A 4-Airplane Operation

Cost Area	Total Cost	Present Value
ETOPS Specific Maintenance	$940,400	$665,100
Polar Operations	$20,800	$17,700
ETOPS Training	$69,200	$58,300
Total	$1,030,400	$741,100

ETOPS Requirements for Airframe and Engine Manufacturers

Airplanes must be designed and built for the intended mission. The proposed rule would codify the type design and engine requirements that are contained in Advisory Circular 120-42A and the Early ETOPS Special Conditions provisions of the B777 program. The proposed rule would amend parts 21, 25, and 33. Manufacturers can opt to either design

for ETOPS operations or not based on their estimates of the market. Manufacturers of current ETOPS approved airframe-engine combinations would not incur significant costs to manufacture two-engine airplanes for beyond 180-minutes ETOPS. Manufacturers who design a supplemental certificate for a three or four-engine airplane would incur costs. Manufacturers of business aircraft would incur costs to certify beyond 180-minutes ETOPS airplanes.

Part 21

Section 21.4 would be added to the aircraft certification procedures and would require type certificate holders to establish ETOPS reporting provisions. The requirements of Section 21.4(a) would focus on problem reporting and tracking under the Early ETOPS program while Section 21.4(b) would require reports on the operational service reliability of twin-engine airplanes used in ETOPS services. Since the proposed rule is a codification of existing policy, manufacturers of existing ETOPS airplanes would not incur any additional costs to comply with these provisions. However, these manufacturers may encounter the need to expand their reporting systems to cover an early ETOPS for a 4-engine airplane. The FAA estimates the cost of extending their reporting system would require the full-time services of 2 Engineering Aides. The total cost over a 10-year period would be $1.9 million or $1.3 million, discounted. See Appendix Table A-17.

Business aircraft are operated under the provisions of both parts 91 and 135 and since part 91 operators would not be required to report engine hours it is likely that the

reporting system for Early ETOPS under section 21.4(a) would be required over the 10-year period. In addition under section 21.4(b), manufacturers of engines and airplanes of twin-engine planes used in ETOPS must report on the reliability of their fleet including in-flight shutdown events (as opposed to rates), and fleet utilization, including operators, flight hours and engine cycles. The reporting may be combined with the existing reporting requirements of section 21.3 that address reporting of failures, malfunctions, and defects. The manufacturer would also have to investigate propulsion system in-flight shutdown causes. While the FAA believes business aircraft manufacturers already maintain robust reporting and investigating systems, these proposed provisions would result in additional costs. The FAA estimates the cost of extending their reporting system would require the full-time services of 2 Engineering Aides. The total cost to a business aircraft manufacturer over a 10-year period is estimated to be $1.9 million or $1.3 million, discounted. See Appendix Table A-17. The FAA estimates that a manufacturer would expend 2,000 hours of engineering and technician time annually investigating shutdown causes. The total cost of these investigations over a 10-year period is estimated to be $1.4 million or $948,000, discounted. See Appendix Table A-18. The FAA requests comments and data on these issues. The total 10-year costs to a business aircraft manufacturer to comply with the proposed amendment to Part 21 are estimated to be $3.2 million or $2.3 million, discounted as shown in Table 9.

Table 9 Estimated Costs per Business Aircraft Manufacturer for ETOPS Reporting Requirements Under Proposed Part 21

Cost Area	Total Cost	Present Value
Reporting	$1,872,000	$1,314,700
Investigations	$1,350,000	$ 948,100
Total	$3,222,000	$2,262,800

Manufacturers of part 121 aircraft would also need to expand their reporting systems to cover an early ETOPS for a 3 or 4-engine airplane at a total cost over a 10-year period of $1.9 million or $1.3 million, discounted.

Part 25

Part 25 addresses the airworthiness standards for transport category airplanes, which includes both parts 121 and 135 ETOPS-eligible airplanes.

Section 25.857(c)(2) would be amended to require that the certified time capability of the Class C cargo fire suppression system be included in the manufacturer's Airplane Fight Manual (AFM). Both parts 121 and 135 would be amended to limit operations beyond 180-minutes under certain conditions to a maximum diversion time based on the cargo fire suppression time contained in the AFM. The FAA estimates that the manufacturer of three and four engine aircraft would incur one-time supplemental certification costs of $1.9 million or $1.8 million, discounted to obtain supplemental type certificates for the cargo fire suppression systems and revise the Airplane Flight Manuals. Boeing business jet (BBJ) aircraft are already certified for 195 minutes fire suppression. The FAA estimates that the cost to obtain a one-time supplemental type certificate for the BBJ cargo fire suppression system and revise the Airplane Flight Manual for a higher diversion time would cost $1.5 million or $1.4 million, discounted. Many business aircraft models do not have Class C cargo holds and would not have to comply with this provision since it only applies "if installed". Manufacturers of other business aircraft

would have an eight-year transition period to allow them to design and produce newly compliant aircraft and for those aircraft to become readily available in the marketplace. The FAA requests comments and data addressing this issue.

Appendix L would be added to Part 25 to set forth airplane type design for ETOPS. Part I would address design requirements including airplane and propulsion systems, flight test requirements, configuration, maintenance and procedures standards and AFM information. It would codify existing policies.

Section I(a)(1) addresses operations in icing conditions which are already required. Section I(a)(2) would require a more robust power supply system. Three or four engine-airplanes already have adequate power supply systems but a more robust electrical system design for twin-engine airplanes would be required. The validity of the design would have to be demonstrated by the applicant. The FAA estimates that the design would require 30,000 hours to develop and would cost $2.25 million or $2.1 million, discounted. The FAA requests comments and data addressing this issue. This section would also mandate three electrical generation sources, which codifies the existing AC criteria, and is already meet by business aircraft that may seek ETOPS approval.

Section I(b) addresses propulsion system requirements. The proposed rule would require that the fuel system design assure positive fuel pressure to the fuel pump, adequate fuel for any fuel pump failure and proper alerts to the flight crew. While newer aircraft such as the B777's fuel system design may serve as the basic standard for beyond 180-minute

fuel systems, the design selected would vary by manufacturer. The issue is less of a concern for three and four-engine aircraft and may only entail minimal costs for these airplane designs. The FAA estimates that the design for two-engine fuel systems would require 30,000 hours to develop and would cost $2.25 million or $2.1 million, discounted. The FAA requests comments and data addressing this issue.

Section I(b)(2) addresses auxiliary power units (APU). While this is not an issue for three or four-engine airplanes or for existing ETOPS approved two-engine airplanes, it may be a cost issue for some business aircraft manufacturers. The FAA does not have a basis to estimate these costs and requests comments and data addressing this issue.

Section I(b)(3) would require the engine oil tank filler to comply with the revised requirements of section 33.71(c)(4). The costs are discussed in Part 33 analyses following these analyses for Part 25.

Section I(c) would require that the procedures for an engine condition monitoring (ECM) process be defined and validated in accordance with section 33.4. The costs are discussed in Part 33 analyses.

Section I(d) would require a flight test to be conducted. The FAA estimates this flight for a business airplane would require 4 hours and cost approximately $40,000 based on the total cost per hour of a Gulfstream G-IV[7].

[7]$9,760 rounded to $10,000. Table 4-20, Economic Values for evaluation of FAA Investment and Regulatory Programs June 1998

Section I(e-f) would require the identification of ETOPS-specific configuration, maintenance and procedures and include ETOPS-specific information in the AFM. The FAA believes any costs associated with these requirements would be accounted for in the other steps of the process.

In addition to the requirements of section I, an applicant for a two-engine airplane would also have to show compliance with the requirements of section II.

Section II of Appendix L to part 25 would require an airframe manufacturer to complete one of three certification methods in order to certify a twin-engine airplane for ETOPS beyond 180 minutes. The methods are: the Service Experience method, which requires accumulating 250,000 world-wide fleet engine hours, a reliability review, and an assessment of all ETOPS significant systems; the Early ETOPS method, which entails a review of previously certified Part 25 airplanes manufactured by the applicant, extensive testing, and an engine approved under proposed section 33.200; and a Combined Service Experience and Early ETOPS method, which reduces the engine hours required by the in-service method but requires a number of the Early ETOPS testing requirements. Manufacturers of current ETOPS approved twin-engine airplanes are already incurring these costs.

Manufacturers of twin-engine business airplanes would incur additional costs to certify an airplane-engine combination for service beyond 180-minutes ETOPS. It is unlikely a

business aircraft would acquire the 250,000 engine hours for operations conducted under part 135 and thus satisfy the in-service method requirement. Given the proposed eight-year phase-in of the airplane requirements of Part 135 Appendix G, a business airplane manufacturer may meet the requirements of the combined method, which requires as few as 15,000 engine hours, plus an assessment of relevant experience, a validation of all maintenance and operational procedures, and testing of any technology new to the applicant, including new manufacturing techniques in addition to the requirements addressed in Section I. The experience assessment would require the applicant to identify specific corrective actions taken to address relevant design, manufacturing, operational and maintenance problems on previously certified Part 25 manufactured by the applicant. While this assessment is subject to variation, the FAA estimates it would require one year of an Engineer's time or a cost of $156,000 or $146,000, discounted to perform this review of past experience. The FAA estimates that validating maintenance and operational procedures would require a manufacturer to expend 10,000 hours of engineering and technician time at an estimated cost of $675,000 or $631,000, discounted. The issue of new technology use or substantially new manufacturing techniques would vary by manufacturer. However, given the sophistication of current business aircraft manufacturers, which already employ the latest technology and manufacturing methods, the FAA estimates this proposed requirement would result in a manufacturer expending 5,000 hours of engineering and technician time at an estimated cost of $ 338,000 or $316,000, discounted.

The total quantified costs to a business aircraft manufacturer to comply with the proposed provisions of Part 25 are estimated at $7.2 million or $6.7 million, discounted as shown in Table 10. The discounted cost assumes all the costs would be incurred in the first year; the costs would probably be incurred over a period of years. The FAA requests comments and data addressing the compliance cost estimates of Part 25.

Table 10- Estimated Costs per Business Aircraft Manufacturer for Part 135 ETOPS Airplane Certification Under Proposed Part 25

Cost Area	Total Cost	Present Value
Cargo Fire Suppression[1]	$1,504,500	$1,406,700
Electrical System Design	$2,250,000	$2,103,750
Fuel System Design	$2,250,000	$2,103,750
Flight Test	$40,000	$37,400
Experience Assessment	$156,000	$145,860
Validation of Procedures	$675,000	$631,120
New Technology Use	$337,500	$315,600
Total	$7,213,000	$6,744,180

1 Only aircraft with Class C Cargo Compartments

Section III of Appendix L to part 25 would require an airframe manufacturer to complete one of three certification methods similar to the methods contained in Section II in order to certify a three or four-engine airplane for ETOPS beyond 180 minutes. Manufacturers of existing three or four-engine airplanes would use the in-service process and would only have to perform and engineering assessment and conduct a flight test. The FAA estimates the engineering assessment would require one year of an Engineer's time or a cost of $156,000 or $146,000, discounted. The FAA estimates that this flight for a 3 or 4-engine airplane would require 6 hours and cost approximately $50,000 based on the

total cost per block hour for a B-747-400[8]. There are no newly certificated U.S.-manufactured three or four-engine airplanes expected within the next ten years.

The total cost of the proposed provisions of Part 25 to a manufacturer of three or four-engine airplanes would be $2.1 million or $2.0 million, discounted. This consists of $1.9 million for supplemental certification of the cargo fire suppression system, $156,000 for an engineering assessment and $50,000 for a test flight.

Part 33

Part 33 addresses the criteria for establishing the airworthiness of aircraft engines. Compliance with the proposed requirements does not constitute approval for ETOPS operations but does make the engine "eligible" for ETOPS operations. Many engines used on business aircraft are derivatives of engines designed for part 121 operations.

Subpart G would be added to part 33 as section 33.200. It would set forth the eligibility and test requirements for an engine to be installed in a twin-engine ETOPS plane that does not have 250,000 engine hours of in-service experience. The proposed changes to this part would require engine manufacturers to use their best design and manufacturing practices. Sections 33.200(a-b) would require engine designers to use all their best design practices to eliminate past failures, malfunctions and design-related maintenance problems experienced with the applicant's other relevant type designs within the past ten years or longer. The FAA estimates that these evaluations would cost approximately

[8] $8,106 rounded to $8,500. Table 4-11, Economic Values for evaluation of FAA Investment and Regulatory Programs June 1998

$250,000 or $234,000, discounted. Sections 33.200(c-e) would require a 3,000-cycle engine test covering all phases of operation. In addition, numerous technical tests such as unbalancing the main engine rotors, vibration tests, and calibration tests would be required. A complete teardown inspection of the engine hardware after completion of the test program would be required and would include an analysis of any abnormal conditions found. The FAA estimates that the test engine would cost approximately $3.25 million and the costs of conducting the 3,000-cycle test would cost an additional $3.25 million. The total cost would be $6.5 million or $6.1 million, discounted. The FAA requests comments and data addressing this issue.

Section 33.71(c) would be amended to incorporate a new design requirement for oil tanks to prevent hazardous oil loss in the event of an oil tank cap installation error. All known engine models installed on Part 121 twin-engine ETOPS airplanes as well as all part 121 three or four-engine airplanes already have this oil tank feature installed. However, it is not known if the engines installed on business aircraft have this feature installed. The FAA estimates that the cost for design, development, and certification of a new oil tank would be approximately $3 million or $2.8 million, discounted. The FAA requests comments and data addressing this issue.

Section 33.4 would be amended to require that procedures for engine condition monitoring be included in the instructions for continued airworthiness. The FAA estimates that it would cost the applicant $375,000 or $351,000, discounted for

engineering staff time to develop these procedures. The FAA requests comments and data addressing this issue.

The total costs to an applicant seeking to certify an engine as "eligible" for use on a 2-engine ETOPS airplane would be $10.1 million or $9.5 million, discounted as shown in Table 11.

Table 11- Estimated Costs to An Applicant Seeking Certification of An Engine for Use on a Two-Engine ETOPS Airplane

Cost Area	Total Cost	Present Value
Type Design Evaluation	$250,000	$234,000
3,000 Cycle Tests	$6,500,000	$6,077,500
Oil Tank Design	$3,000,000	$2,805,000
Engine Condition Monitoring	$375,000	$351,000
Total	$10,125,000	$9,467,500

Summary of Quantified Costs of Proposed ETOPS Rule

New ETOPS Operators and Airframe-Engine Manufacturers

Compliance with the proposed rule is voluntary for all operators, and airframe-engine manufacturers. Since the FAA cannot estimate how many entities would choose to operate ETOPS beyond 180-minutes, the FAA has estimated the costs of the rule over a 10-year period to individual operators.

The FAA estimates that the cost of the rule to a new entrant Part 121 operator of a twin-engine airplane would be approximately $106,000 over 10 years more than the operator would incur under the existing deviation policy and procedures. This reflects the cost of

preparing and maintaining a passenger recovery plan and maintenance investigation and resolution costs for a four-airplane ETOPS operation.

A Part 121 operator of a three or four-engine fleet serving a single route beyond 180-minutes would incur costs of approximately $3.7 million over 10 years. It is assumed that the route would require a four-airplane fleet with 60 crewmembers, supported by 2 dispatchers and 20 mechanics.

A Part 135 operator seeking authorization to conduct ETOPS operations beyond 180-minutes would incur costs of approximately $1.0 million over 10 years. This estimate is based on a fleet of 4 airplanes flown by a crew of 16 pilots and maintained by 2 certified mechanics, and each aircraft conducts a monthly ETOPS operation. The fleet excludes aircraft with a Class C cargo compartment. Aircraft with Class C cargo compartments would add $1.5 million to the cost. All aircraft are capable of operating between the West Coast-Hawaii. Currently 6 operators that are authorized to fly between the West Coast and Hawaii only operate airplanes that would not be acceptable to the FAA under the proposed rule. These operators would have to upgrade to an acceptable aircraft at an estimated cost of $4 million per aircraft to continue these flights.

A business aircraft manufacturer would incur reporting and investigation costs that would be required by the proposed provisions of Part 21 estimated at $3.2 million over 10 years. This expenditure would be incurred to fund 2 full-time staff for reporting purposes and a full-time staff member to conduct investigations of incidents. The manufacturer would

also incur airplane ETOPS certification costs of $7.2 million. This would consist of design costs of $6 million, and assessment and validation costs of $1.2 million. Engine certification costs that would be required to make an engine ETOPS eligible would cost $10.1 million. This would consist of design costs of $3.2 million, testing costs of $6.5 million and establishing engine-monitoring procedures at a cost of $400,000. The total cost to a business aircraft manufacturer for reporting and investigation, and airframe and engine certification would be $20.6 million.

The manufacturer of an existing three or four-engine plane would incur additional reporting costs under part 21 of $1.9 million to include operators that choose to fly beyond 180-minutes, supplemental certification costs of $1.9 million to allow operators of existing three or four-engine airplanes to increase the capacity of the cargo fire suppression system required for beyond 180-minutes ETOPS and other required costs of $200,000 for a total cost of $4 million.

The quantified costs to all the individual entities affected by the proposed rule are summarized in Table 12. The FAA requests comments and data addressing these estimates.

Table 12- Estimated Ten Year Quantified Costs of Proposed Rule to Individual Entities

Cost Area	Total Cost	Present Value
Cost to a New Part 121 Twin-Engine ETOPS Operator	$ 106,500	$ 75,900
Cost to a 3 or 4-Engine Operator	$ 3,676,500	$2,789,500
Cost to a Part 135 Operator	$ 1,030,400	$ 741,100
Costs to a Business Aircraft Manufacturer for Reporting and Investigation, and	$ 20,560,000	$18,474,500

Certification of Airframe and ETOPS-Eligible Engine		
Reporting and Certification Costs to Manufacturer of 3-4engine airplane	$3,958,500	$3,265,700

In addition, the total cost of the provisions of the proposed rule for existing two-engine ETOPS operators over a ten-year period beyond those incurred to comply with the existing policy and guidance is estimated at $10.7 million or $7.6 million, discounted.

The total costs to the industry are estimated at $265.3 million over a ten-year period or $217.7 million, discounted as shown in Table 12A. These costs are based on the following assumptions:

- Costs to existing 2-engine operators as shown in the Regulatory Evaluation
- Costs for a single operator, as shown in the Regulatory Evaluation, are multiplied by the number in the first column for each row to obtain the Total Cost and Present Value columns.
- There are currently 7 "low cost" passenger carriers (AirTran, America West, ATA, Frontier, JetBlue, Southwest, and Spirit as defined by the Aviation Daily). It is assumed each would operate 4 ETOPS airplanes on a single route.
- There are currently 13 U.S. operators of 3-or 4-engine aircraft and it is assumed each would operate 1 route beyond 180 minutes.
- There are 81 Part 135 operators that both meet the proposed aircraft and maintenance requirements.
- There are 3 "makes" of 3- or 4-engine airplanes (B-747, DC-10, MD-11)
- There are 5 "major" business airplane manufacturers serving this market segment. (Boeing, Cessna, Gulfstream, Raytheon, and Sabreliner)
- There are 6 current Part 135 operators using airplanes that could not be upgraded to meet the specifications of the proposed rule. It would cost each operator approximately $4 million to replace a single airplane to meet the specifications.

Table 12A Estimated Ten-Year Costs to Industry

Costs Incurred by:	Total Cost	Present Value
Existing 2-engine Operators	$10,735,500	7,559,400
7 New 2-engine Operators	$745,500	$531,300
13 3-or4-engine Operators	$47,794,500	$36,263,500
81 Part 135 Operators	$83,462,400	$60,029,100
Reporting and Certification Costs for 3 makes of 3 or 4 engine airplanes	$11,875,500	$9,797,100
5 Business Aircraft Manufacturers Part 25 costs	$36,065,000	$33,720,900
5 Business Aircraft Manufacturers Part 33 Costs	$50,625,000	$47,337,500
Current Part 135 Operators Aircraft Replacement Costs	$24,000,000	$22,440,000
Total Costs	$265,303,400	$217,678,800

INITIAL REGULATORY FLEXIBILITY DETERMINATION

The Regulatory Flexibility Act of 1980 (RFA) establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation." To achieve that principle, the RFA requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions. The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

This proposed rule would affect airframe and engine manufacturers and part 121 and part 135 operators engaged in ETOPS operations. All United States manufacturers of transport category airplanes exceed the Small Business Administration small entity criteria of 1,500 employees for aircraft manufacturers. Those U.S. manufacturers include: Boeing, Cessna, Gulfstream, Lockheed Martin, McDonnell Douglas, Raytheon, and Sabreliner. All United States manufacturers of ETOPS-capable engines exceed the Small Business Administration small entity criteria of 1,000 employees for aircraft engine manufacturers. Those U.S. manufacturers include: General Electric, Pratt & Whitney, and Rolls Royce. All United States operators of transport category airplanes that are currently authorized to conduct 180- minute ETOPS operations exceed the Small Business Administration small entity criteria of 1,500 employees for scheduled and non-scheduled air transportation firms. Those U.S, operators include: American, American Trans Air, Continental, Delta, United, US Airways, and UPS. There are a number of small non-scheduled part 121 operators that operate 3 or 4 engine airplanes that have the

capability to operate ETOPS flights beyond 180 minutes. Those operators include: Atlas, Evergreen, Gemini, Kalitta, Southern Air, Polar, and World. There are a number of small non-scheduled part 135 operators that operate 2 engine airplanes that have the capability to operate ETOPS flights beyond 180 minutes. These non-scheduled part 121 and part 135 operators are not required to conduct beyond 180-minutes ETOPS operations. Those who voluntarily decide to equip their airplanes and conduct the required training and planning under this proposed rule will have made their own business decisions that the costs associated with this NPRM are less than the cost savings of operating beyond 180-minutes ETOPS flights. The FAA therefore certifies that the proposed rule would not have a significant economic impact on a substantial number of small operators. The FAA seeks public comments regarding this finding and requests that all comments be accompanied with detailed supporting data.

TRADE IMPACT ASSESSMENT

The Trade Agreement Act of 1979 prohibits Federal agencies from establishing any standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

This proposed rule would impose requirements on airframe and engine manufacturers that both domestic and foreign firms would have to comply with. U.S. operators of 3 and

4 engine airplanes that seek authority to operate beyond 180-minutes ETOPS flight would have to comply with the same proposed equipment and training provisions regardless of the country of origin of the aircraft or engine manufacturer. Also the FAA does not believe that U.S. operators of 3 and 4 engine airplanes would be placed at a competitive disadvantage to foreign operators of 3 and 4 engine airplanes as a result of this proposed rule. The FAA seeks public comments regarding this finding and requests that all comments be accompanied with detailed supporting data.

The FAA concludes that these proposed requirements would have a neutral impact on foreign trade and, therefore, create no obstacles to the foreign commerce of the United States.

UNFUNDED MANDATES ASSESSMENT

The Unfunded Mandates Reform Act of 1995 (the Act) is intended, among other things, to curb the practice of imposing unfunded Federal mandates on State, local, and tribal governments. Title II of the Act requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (adjusted annually for inflation) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a "significant regulatory action."

This proposed rule does not contain such a mandate. The requirements of Title II do not apply.

Appendix

Table A-1 Cost of Preparing and Maintaining Passenger RecoveryPlans						
Year	# of Plans*	StaffHours	CostperHr	Total Cost	Discount	Present Cost
1	19	100	$75	$142,500	0.935	$133,238
2	19	40	$75	$57,000	0.873	$49,761
3	19	40	$75	$57,000	0.816	$46,512
4	19	40	$75	$57,000	0.763	$43,491
5	19	40	$75	$57,000	0.713	$40,641
6	19	40	$75	$57,000	0.666	$37,962
7	19	40	$75	$57,000	0.623	$35,511
8	19	40	$75	$57,000	0.582	$33,174
9	19	40	$75	$57,000	0.544	$31,008
10	19	40	$75	$57,000	0.508	$28,956
Total				$655,500		$480,254
* Excludes existing polar plans						

		Table A-2			
Cost to Investigatre "Typical" Incidents and Take Corrective Action					
Year	Annual Staff Hours Required	Cost per Hour	Annual Cost	Discount	Present Value
1	22400	$45	$1,008,000	0.935	$942,480
2	22400	$45	$1,008,000	0.873	$879,984
3	22400	$45	$1,008,000	0.816	$822,528
4	22400	$45	$1,008,000	0.763	$769,104
5	22400	$45	$1,008,000	0.713	$718,704
6	22400	$45	$1,008,000	0.666	$671,328
7	22400	$45	$1,008,000	0.623	$627,984
8	22400	$45	$1,008,000	0.582	$586,656
9	22400	$45	$1,008,000	0.544	$548,352
10	22400	$45	$1,008,000	0.508	$512,064
Total	224000		$10,080,000		$7,079,184

Table A-3 Cost to Install New Communication Equipment on 4 Airplanes					
Year	# Aircraft	Installed	Total	Discount	Present
		Cost	Cost		Value
1	2	$223,000	$446,000	0.935	$417,010
2	2	$223,000	$446,000	0.873	$389,358
Total	4		$892,000		$806,368

Table A-4 Fuel Cost of Installing 4 Communication Systems						
Year	Number of	Extra Fuel	Cost	Total	Discount	Present
	Planes	(Gals)	perGal	Cost		Value
	Modified					
1	2	1292	0.77	$ 995	0.935	$ 930
2	4	2584	0.77	$ 1,990	0.873	$ 1,737
3	4	2584	0.77	$ 1,990	0.816	$ 1,624
4	4	2584	0.77	$ 1,990	0.763	$ 1,518
5	4	2584	0.77	$ 1,990	0.713	$ 1,419
6	4	2584	0.77	$ 1,990	0.666	$ 1,325
7	4	2584	0.77	$ 1,990	0.623	$ 1,240
8	4	2584	0.77	$ 1,990	0.582	$ 1,158
9	4	2584	0.77	$ 1,990	0.544	$ 1,082
10	4	2584	0.77	$ 1,990	0.508	$ 1,011
Total				$ 18,902		$ 13,043

Table A-5 Fixed Operating Cost of 4 Communication Systems					
Year	Number of	Annual	Total	Discount	Present
	Planes	Fixed	Cost		Value
	Modified	Cost			
1	2	$2,000	$4,000	0.935	$3,740
2	4	$2,000	$8,000	0.873	$6,984
3	4	$2,000	$8,000	0.816	$6,528
4	4	$2,000	$8,000	0.763	$6,104
5	4	$2,000	$8,000	0.713	$5,704
6	4	$2,000	$8,000	0.666	$5,328
7	4	$2,000	$8,000	0.623	$4,984
8	4	$2,000	$8,000	0.582	$4,656
9	4	$2,000	$8,000	0.544	$4,352
10	4	$2,000	$8,000	0.508	$4,064
Total			$76,000		$52,444

Table A-6 Cost to Modify 4 Airplanes Cargo Fire Suppression Systems					
Year	# Aircraft	Kit Cost Installed Inc. 1 Halon Bottle	Total Cost	Discount	Present Value
1					
2					
3					
4	1	$76,440	$76,440	0.763	$58,324
5	1	$76,440	$76,440	0.713	$54,502
6	1	$76,440	$76,440	0.666	$50,909
7	1	$76,440	$76,440	0.623	$47,622
8					
9					
10					
Total	4		$305,760		$211,357

Table A-7 Fuel Cost of Modifying 4 Cargo Fire Suppression Systems						
Year	Number of Planes Modified	Extra Fuel (Gals)	Cost perGal	Total Cost	Discount	Present Value
1						
2						
3						
4	1	6,225	0.77	$ 4,793	0.763	$ 3,657
5	2	12,450	0.77	$ 9,587	0.713	$ 6,835
6	3	18,675	0.77	$ 14,380	0.666	$ 9,577
7	4	24,900	0.77	$ 19,173	0.623	$ 11,945
8	4	24,900	0.77	$ 19,173	0.582	$ 11,159
9	4	24,900	0.77	$ 19,173	0.544	$ 10,430
10	4	24,900	0.77	$ 19,173	0.508	$ 9,740
Total		136,950		$ 105,452		$ 63,343

Table A-8		
"One Time"Costs of ETOPS Maintenance Program		
	Total Cost	Present Value
Develop ETOPS Document	$44,200	$41,327
Develop Pre-departure Check	$20,400	$19,074
ETOPS Task Identification	$700	$655
Develop Reliability Program	$17,000	$15,895
Total	$82,300	$76,951

Table A-8-1 Cost of Pre-departure Checks			
Year	Cost	Discount	Present $
1	$ 98,550	0.935	$ 92,144
2	$ 98,550	0.873	$ 86,034
3	$ 98,550	0.816	$ 80,417
4	$ 98,550	0.763	$ 75,194
5	$ 98,550	0.713	$ 70,266
6	$ 98,550	0.666	$ 65,634
7	$ 98,550	0.623	$ 61,397
8	$ 98,550	0.582	$ 57,356
9	$ 98,550	0.544	$ 53,611
10	$ 98,550	0.508	$ 50,063
Total	$ 985,500		$692,117

Table A-8-2 Investigation Costs			
Year	Cost	Discount	Present $
1	$ 7,200	0.935	$ 6,732
2	$ 7,200	0.873	$ 6,286
3	$ 7,200	0.816	$ 5,875
4	$ 7,200	0.763	$ 5,494
5	$ 7,200	0.713	$ 5,134
6	$ 7,200	0.666	$ 4,795
7	$ 7,200	0.623	$ 4,486
8	$ 7,200	0.582	$ 4,190
9	$ 7,200	0.544	$ 3,917
10	$ 7,200	0.508	$ 3,658
Total	$ 72,000		$ 50,566

Table A-9		
Continuing Costs of Implementing ETOPS Mtnce		
	Total	Present
	Cost	Value
Predepature checks	$985,500	$ 692,100
Investigate Occurrances	$72,000	$ 50,600
Additional Staff	$936,000	$ 657,400
Total	$1,993,500	$ 1,400,100

TableA-10-1	Cost to Prepare Recovery Plan						
Year	# of Plans	Initial Hrs	Annual Hrs	Cost per Hr	Total Cost	Discount	Present
							Value
1	1	100		$75	$7,500	0.935	$7,013
2	1		40	$75	$3,000	0.873	$2,619
3	1		40	$75	$3,000	0.816	$2,448
4	1		40	$75	$3,000	0.763	$2,289
5	1		40	$75	$3,000	0.713	$2,139
6	1		40	$75	$3,000	0.666	$1,998
7	1		40	$75	$3,000	0.623	$1,869
8	1		40	$75	$3,000	0.582	$1,746
9	1		40	$75	$3,000	0.544	$1,632
10	1		40	$75	$3,000	0.508	$1,524
Total					$34,500		$25,277

Table A-10-2 Cost of Initial and Annual Training per Operator of 3 or 4-Engine Fleet						
Year	# of Staff	# Hours	Cost perHr.	Total Cost	Discount	Present Value
Initial						
Pilots	20	16	$173	$55,360		
Attendants	40	4	$52	$8,320		
Dispatcher	8	12	$38	$3,648		
Year 1 Total				$67,328	0.935	$62,952
2		1	$ 5,884	$ 5,884	0.873	$5,137
3		1	$ 5,884	$ 5,884	0.816	$4,801
4		1	$ 5,884	$ 5,884	0.763	$4,489
5		1	$ 5,884	$ 5,884	0.713	$4,195
6		1	$ 5,884	$ 5,884	0.666	$3,919
7		1	$ 5,884	$ 5,884	0.623	$3,666
8		1	$ 5,884	$ 5,884	0.582	$3,424
9		1	$ 5,884	$ 5,884	0.544	$3,201
10		1	$ 5,884	$ 5,884	0.508	$2,989
Total				$120,284		$98,773

Table A-11	Cost of Pre-departure checks to a Part 135 Operator						
Yr	# A/c	# check/AC	Total Checks	$ Per	Total Cost	Discount	Present Value
1	4	24	96	45	$ 4,320	0.935	$ 4,039
2	4	24	96	45	$ 4,320	0.873	$ 3,771
3	4	24	96	45	$ 4,320	0.816	$ 3,525
4	4	24	96	45	$ 4,320	0.763	$ 3,296
5	4	24	96	45	$ 4,320	0.713	$ 3,080
6	4	24	96	45	$ 4,320	0.666	$ 2,877
7	4	24	96	45	$ 4,320	0.623	$ 2,691
8	4	24	96	45	$ 4,320	0.582	$ 2,514
9	4	24	96	45	$ 4,320	0.544	$ 2,350
10	4	24	96	45	$ 4,320	0.508	$ 2,195
Total					$ 43,200		$ 30,339

	Table A-12 Maintnenance Training Costs					
Year	Initial Hrs	Annual Hrs	CostperHr	Total Cost	Discount	Present Value
1	8		$45	$360	0.935	$337
2		2	$45	$90	0.873	$79
3		2	$45	$90	0.816	$73
4		2	$45	$90	0.763	$69
5		2	$45	$90	0.713	$64
6		2	$45	$90	0.666	$60
7		2	$45	$90	0.623	$56
8		2	$45	$90	0.582	$52
9		2	$45	$90	0.544	$49
10		2	$45	$90	0.508	$46
Total				$1,170		$885

Table A-13 Reporting Costs					
Year	Annual Hours	Cost per Hr	Total Cost	Discount	PV
1	8	$45	$ 360	0.935	$ 337
2	8	$45	$ 360	0.873	$ 314
3	8	$45	$ 360	0.816	$ 294
4	8	$45	$ 360	0.763	$ 275
5	8	$45	$ 360	0.713	$ 257
6	8	$45	$ 360	0.666	$ 240
7	8	$45	$ 360	0.623	$ 224
8	8	$45	$ 360	0.582	$ 210
9	8	$45	$ 360	0.544	$ 196
10	8	$45	$ 360	0.508	$ 183
Total			$ 3,600		$ 2,528

Table A-14	Recovery plan					
Year	Initial Hrs	Annual Hrs	CostperHr	Total Cost	Discount	Present Value
1	40		$75	$3,000	0.935	$2,805
2		10	$75	$750	0.873	$655
3		10	$75	$750	0.816	$612
4		10	$75	$750	0.763	$572
5		10	$75	$750	0.713	$535
6		10	$75	$750	0.666	$500
7		10	$75	$750	0.623	$467
8		10	$75	$750	0.582	$437
9		10	$75	$750	0.544	$408
10		10	$75	$750	0.508	$381
Total				$9,750		$7,371

Table A-15 Cost of Polar Operations		
Area	Total Cost	Present value
Recovery		
Plan	$9,750	$7,370
Exposure		
Suits	$3,000	$2,800
Crew		
Training	$8,000	$7,480
Total	$20,750	$17,650

Table A-16 Cost Pilot Training						
Year	Initial Hrs	Annual Hrs	CostperHr	Total Cost	Discount	Present Value
1	256		$173	$44,288	0.935	$41,409
2		16	$173	$2,768	0.873	$2,416
3		16	$173	$2,768	0.816	$2,259
4		16	$173	$2,768	0.763	$2,112
5		16	$173	$2,768	0.713	$1,974
6		16	$173	$2,768	0.666	$1,843
7		16	$173	$2,768	0.623	$1,724
8		16	$173	$2,768	0.582	$1,611
9		16	$173	$2,768	0.544	$1,506
10		16	$173	$2,768	0.508	$1,406
Total				$69,200		$58,261

Table A-17 Cost of Extended Reporting Systems			
Year	Annual Cost	Discount	Present
			Value
1	$187,200	0.935	$175,032
2	$187,200	0.873	$163,426
3	$187,200	0.816	$152,755
4	$187,200	0.763	$142,834
5	$187,200	0.713	$133,474
6	$187,200	0.666	$124,675
7	$187,200	0.623	$116,626
8	$187,200	0.582	$108,950
9	$187,200	0.544	$101,837
10	$187,200	0.508	$95,098
Total	$1,872,000		$1,314,706

Table A-18 Cost of INVESTIGATING SHUTDOWNS			
Year	Annual Cost	Discount	Present
			Value
1	$135,000	0.935	$126,225
2	$135,000	0.873	$117,855
3	$135,000	0.816	$110,160
4	$135,000	0.763	$103,005
5	$135,000	0.713	$96,255
6	$135,000	0.666	$89,910
7	$135,000	0.623	$84,105
8	$135,000	0.582	$78,570
9	$135,000	0.544	$73,440
10	$135,000	0.508	$68,580
Total	$1,350,000		$948,105