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FAA-02-6717-83

Docket No. FAA-2002-6717; Notice No. 03-11
Extended Operations (ETOPS) of Multi-engine Airplanes

March 3rd 2004

Dear Sir or Madam:

Re: Docket No. FAA-2002-6717; Notice No. 03-11

This letter and accompanying documentation is submitted by the **International Aviation Safety Association** (**IASA**) in accordance with the FAA's request for interested persons to participate in the above proposed rulemaking by submitting written comments, data, or views. As requested this documentation is filed in duplicate.

Our submission is arranged as follows:

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Please note that all references to the Transportation Safety Board of Canada Final Report into the September 2 1998 crash of Swissair 111 are in **BOLD**.

Section 1 - Opening Remarks

1. The proposed rule for Extended Operations (ETOPS) of Multi-engine Airplanes provides analysis and mitigation of risks associated with propulsion system failures, fuel system malfunction, system redundancy, operational errors and ground rescue/firefighting requirements. However, we believe that the ARAC ETOPS Working Group overlooked the impact of smoke-related events on safety and airline costs as it relates both to the increased risk associated with the inability to land immediately within an incident or accident scenario.

2. Mrs. Lyn S Romano formed IASA on March 4, 1999. Mrs. Romano's husband, Mr. Raymond M Romano, was one of the 229 people killed aboard Swissair 111 on September 2, 1998. The Transportation Safety Board of Canada (TSB) reported upon their investigation into the crash on March 27, 2003. We believe that the TSB's findings and certain of their safety recommendations (to be discussed below) are pertinent to the matters currently under discussion. We consider this approach a most appropriate one in light of the "lessons learned" as applied by Boeing to certify the B777 for ETOPS.

3. The TSB specifically dealt with the issue of continuous smoke, Section 1.14.4:

   > **"It can take time for odour or smoke to develop to the concentration necessary for the crew to cognitively establish that they are dealing with an abnormal situation. This can delay the initiation of checklist actions."**

4. When the source of odour/smoke is not readily apparent, flight crews are trained to follow checklist troubleshooting procedures to eliminate the origin of the odour/smoke. Most of these procedures involve removing electrical power or isolating an environmental system. A variable amount of time is required to assess the impact of each action, typically to see whether the odour/smoke dissipates... The longer it takes to complete a prescribed checklist that is designed to de-energize a smoke source, the greater the chance that the smoke source could intensify or become an ignition source and start a fire."

5. As further referenced in the Transportation Safety Board's Swissair Flight 111, August 28, 2001 Safety Recommendations concerning the FAA's Research and Development focus in the 1980's"[1]

[1] http://www.tsb.gc.ca/en/media/saf_actions/recommendations/matflamrecsaug2001.asp

"This FAA research also concluded that incapacitation of any potential survivors was primarily dependant upon toxic gases generated by a phenomenon known as "flashover". At flashover, conditions rapidly deteriorate to a level at which survival is unlikely".

"...some in-flight fires have shown that smoke will migrate to the occupied areas of the aircraft and can impede the crew's ability to effectively deal with the associated emergency (see examples in Appendix B attached). Furthermore, with present regulations, no material is required to pass certification fire test that measures toxicity. Beyond meeting a standard of flame time and burn length, there is no regulatory requirement to determine additional flammability characteristics for many materials used in aircraft".

6. Under the current certification practices, and despite specific recommendations, there is no assurance that the smoke can be evacuated. This because no aircraft flying today has been certified to FAA recommended standards for cockpit smoke control – manufacturers have taken a minimum standard approach to this issue. At the very least, 180+ ETOPS aircraft should adhere to recommended standards included in part 25 advisory materials. The Flight crew should be provided with equipment, backup systems or procedures to assure their ability to see and perform their emergency and normal checklists, and be assured of their ability to see-to-land the aircraft.

7. We believe that two issues further compound the issue of continuous dense smoke:

    a. First, that the current regulations mandate less stringent material flammability standards to those materials intended for use within the pressure vessel but that were outside the occupied areas. (TSB Report Section 1.14.1.2).
    b. Second, on today's transport category aircraft, fire detection sensors are required on the propulsion system, lavatories and *cargo compartments*. For cargo compartment smoke detectors, minimum performance standards have not been established – in a location where the flight crew cannot make a visual verification of the presence of smoke or fire.

8. While we cannot calculate the risk of losing an aircraft due to fire, we are convinced that such a loss would cause loss of public confidence in the safety of extended range air transport operations. It goes without saying that both the loss of life and the impact this has on victim's families or loved ones is incapable of quantification but should nevertheless be a component part of the policy's decision-making process.

9. Even with improved detection systems, it is not reasonable to conclude that events of fire and its byproduct and consequences (smoke, fumes and visibility loss) will be eliminated. The nature of ETOPS operations places these aircraft at considerable risk of uncontrollable smoke due to the extended distance from a much earlier landing.

10. We respectfully ask the Administrator to consider and address the following issues in the ETOPS rule. At a minimum these should apply to 180 + minute ETOPS operations.

Section 2 - Rule Considerations

11. We propose the following rule considerations:

1) Establish Smoke Detection system reliability standards for ETOPS operations that equal or exceed propulsion system standards.
2) Assure that flight crew's ability to deal with "non-normal" worst-case system failure conditions specifically include protection from events of dense and continuous flight deck smoke that could be statistically expected to occur in service.
3) Classify **cabin** smoke prevention/ detection/ and fire-fighting capabilities as ETOPS significant systems.

Section 3 - Rule Considerations – Expanded

12. It is our contention that the NPRM relies upon the instrument approach to its alternate airfield being conducted safely via the accuracy with which the airplane can be controlled by reference to flight instruments.

> "This is necessary to assure that the instrument approach can be conducted safely if the flight must divert to an alternate airport. The visual reference necessary to safely complete an approach and landing is determined, among other things, by the accuracy with which the airplane can be controlled along the approach path by reference to instruments and the accuracy of the ground-based instrument aids, as well as the tasks the pilot is required to accomplish to maneuver the airplane so as to complete the landing".

13. Another area of concern is the level of fire-fighting capabilities available at alternate airports. As reported by ABC News[2] Fire-fighters at San Francisco International Airport report that their training requirements are not being met sufficiently. As discussed in the TSB's aviation safety recommendations A00-16 to A00-20, a flight-crew has only a limited ability to effectively assess and suppress hidden, inaccessible fires. Therefore, in its incipient stages, the most likely in-flight fire scenario would involve an uncontrolled fire comprising known flammable materials. As there are no mandated toxicity criteria for materials used within aircraft, some of these materials are likely toxic when burned. Such toxic by-products would be spread by the air circulation within the pressurized hull and could eventually impair crew and passengers. While it can be argued that the crew are equipped with breathing apparatus that allows them to continue to function, passengers have no such equipment. The passenger oxygen delivery system is designed to be used for descent in a depressurization event and will not protect the user against smoke or inhaled toxins or eye inflammation.

14. Some in-flight fires have been resolved with minimal on-board fire-fighting coupled with immediate action to land the aircraft (with flight crew smoke-masks and goggles donned). However, immediate access to an emergency airport may not always be an option, such as during a transoceanic flight. In such cases, passengers could suffer from prolonged exposure to combustion by-products with an unknown effect on their ability to survive. The Board has concerns about the lack of standards to limit the amount of toxic emissions that would potentially be released by burning materials within an aircraft. It believes that the associated risks could be mitigated by eliminating the use of materials that sustain or propagate fire.

15. The need for specific regulatory intervention is reinforced by reference to Advisory Circular 120-42A.

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[2] http://abcnews.go.com/sections/GMA/GoodMorningAmerica/GMA030114Firefighter_training.html

"Cockpit and Cabin Environment - It should be shown that an adequate cockpit and cabin environment is preserved following all combinations of propulsion and electrical system failures which are not shown to be extremely improbable". (4 Paul Halfpenny report)

16. We believe that this could be achieved by an amendment to Group 2 Systems (Section 3) (underlined below):

    "(3) Systems whose failure would result in excessive crew workload or have operational implications or visual incapacitation of the crew or significant detrimental impact on flight crew or passengers physiological well-being for an ETOPS diversion (for example flight control forces that would be exhausting for a maximum ETOPS diversion, system failures that would require continuous fuel balancing to ensure proper Center of Gravity (CG), or a cabin environmental control failure that could cause extreme heat or cold that it could incapacitate the crew or cause physical harm to the passengers ".

17. Special consideration must be given to improved complements of Emergency Equipment (as required by ETOPS MEL) needed to minimize the effects of extended diversion times during LAND IMMEDIATELY emergencies such as continuous flight deck smoke. From a historical perspective the risk of crew incapacitation due to restricted vision increases dramatically with increased diversion time. Other systems functionality, including the flight-crew's life-support, (basic and essential for safe completion of the flight) must be protected and accorded a first-order design priority.

18. Accordingly we would propose that 180+ ETOPS aircraft meet recommended and optional standards for continuous smoke protection and testing per AC25.9a to ensure that: continuous contamination (for a period of time greater than three minutes) of the flight deck by smoke or vapor does not deprive the crew of vision. We would propose the following additional provision in the NPRM posting to address this:

    1) Means shall be provided to prevent continuous contamination (for a period of time greater than three minutes) of the flight deck by smoke or vapor from depriving the crew of vision, from the design eye position, of

    2) Clear vision outside in the general field of the intended direction of flight.

    3) Primary flight information needed to inform the crew of the current flight condition and the status of flight guidance, flight control, and navigation and aircraft systems and provide information required to control the aircraft and monitor its progress with respect to the desired flight path.

    4) Required checklists and navigational materials.

Section 4 - Justification

19. The NPRM discusses the concept of relevant experience assessment, or "lessons learned" as applied by Boeing to certify the B777 for ETOPS. This concept requires the manufacturers and operator to review failures under previous operations and assure that the cause(s) of those failures are mitigated. Data shows that smoke-related events occur

frequently and can lead to catastrophic consequences; thus we conclude that an objective evaluation of the risks would include mitigation strategies for smoke-related events.

Section 5 - Justification - Expanded

20. It is widely accepted that the longer it takes to complete a prescribed trouble-shooting smoke checklist that is designed to de-energize a smoke source, the greater the chance that the smoke source could intensify or become an ignition source, start a fire and interdict systems. It naturally follows that once focus or attention to an uncontrolled fire is lost, the chances of success diminish rapidly. We would again draw your attention to the TSB's March 27, 2003 report. Section 1.14.5:

> **"... when an event that produces odour/smoke evolves into an unsuppressed in-flight fire, there is a limited amount of time to safely land the aircraft. Therefore, the decision to initiate a diversion or emergency descent or both must be made quickly to put the aircraft in a position for an emergency landing if that becomes necessary."**

21. See also Section 1.14.6:

> **"An effective firefighting plan must include procedures that include the optimum involvement of flight and cabin crew to detect, locate, access, assess, and suppress an in-flight fire in a coherent and coordinated manner. When smoke from an unknown source is detected, pilots must take immediate action to prepare for a landing as soon as possible along with other appropriate checklist actions. Such preparations optimally would involve the pilots and underscores the importance of involving other crew members in helping to deal with detection and suppression of the fire or potential fire situation.**

22. See further: **"In the event that the aircraft is at a geographical location from which a timely landing at a suitable airport is not feasible, pilots must be trained to consider alternatives, such as preparing for a potential forced landing or ditching. In such a circumstance, the capability to locate and extinguish the fire is critical. Typically, aircraft crews are not trained to implement such immediate measures."**

23. We contend that time is a critical factor in a smoke/odour/in-flight fire situation both in terms of determining the source of the smoke/odour, the location of the fire and the time necessary to land the aircraft. Flight-crews who eventually resolve to ditch the airplane would probably not be stimulated to make that decision until conditions had worsened to the extent that a successful ditching would be unlikely – due to systems degradation and pilot near-incapacitation. Large underslung turbine engines have a negative ditching connotation and pilots would realize that any decision to ditch would automatically have fatal consequences for many. Because of this, pilots are unlikely to make early ditching decisions and (ipso facto) are then even likelier *not to achieve* a successful outcome. Passengers are equally unlikely to remain seated in the event of a significant fire and the likelihood of an unmanageable C of G problem arising (due to passenger repositioning) must also be taken into account.

24. The TSB report states at Section 1.16.17.2 states:

> **"The TSB reviewed data on in-flight fires that occurred between January 1967 and September 1998 to determine the average time between when an in-flight fire is detected and when the aircraft either ditches, conducts a forced landing, or crashes. ... The data showed that in 15 representative occurrences, between 5 and 35 minutes transpired between the detection of the first fire symptoms and the crash of the aircraft."**

25. ALPA concluded in a 2000 study of US airline data that in-flight smoke incidents were reported by FAA to have occurred at least 1000 times during the first ten months of 1999, during the same period in-flight smoke caused 360 emergency or unscheduled landings of commercial airliners:

> "Overall the majority of smoke and fire events end with a good outcome. The problem is that many of these events end this way because the aircraft was close to a suitable landing site (1 ARG/US report, 2 ASG report). These outcomes would in many cases have been much worse had the aircraft been "far from home".

26. In *A Review of Smoke and Potential In-flight Fire Events in 1999* (Jim Shaw, Air Line Pilots Association) the following observations were made:

    a. "In most cases the crew had limited ability to recognize, or control the malfunction, or have access to the area of the malfunction"

    b. "A large majority of the "high temperature" events occur in or near the cabin or cockpit"

    c. "There appears to be an under-reporting of significant events in the FAA incident database"

    d. "There is an average of more than one unscheduled landing a day due to smoke or fire based only on SDR data"

27. Further, a 2001 industry study concluded that the incidence of smoke and related emergency or unscheduled landings were continuing and had not improved since the 1999 ALPA study. (Smoke and Fire Events for 2001, Jim Shaw).

28. At Section 1.16.17.1 the TSB report refers to analysis of in-service events undertaken by the Boeing Company:

> **"The Boeing Company performed an analysis of reported in-service events, occurring between November 1992 and June 2000, that involved smoke, fumes, fire, or overheating in the pressurized areas of Boeing-manufactured aeroplanes. The events under study were assigned one of three general source categories: air conditioning, electrical, or material. Boeing attributed 64 per cent of the events under study to electrical sources, 14 per cent of the events to air conditioning sources, and 12 per cent of the events to material sources. The remaining 10 per cent of the reported events did not include sufficient information to determine the source of the smoke, fumes,**

fire, or heat. For those events involving MD-11 or DC-10 aircraft, 51 per cent were classified as being electrical in nature, 21 per cent were attributed to air conditioning, and 15 per cent were associated with material causes."

29. The Boeing study concluded that "larger airplanes with more complex systems show a predominance of smoke events of electrical origin, compared with air-conditioning and material smoke events." The Boeing study also concluded that "for smoke events in which the flight crew could not determine the smoke source, most were subsequently determined by maintenance crews to be of electrical origin."

30. As noted above, the likelihood of a smoke/odour/fire scenario is compounded by the lack of regulatory intervention/consistency as far as the flammability requirements of materials are concerned regardless of their geographical location within an aircraft. The TSB's August 28, 2001 "Material Flammability" recommendations proposed a uniformed and comprehensive approach in order to reduce the incidence of smoke/odour/fire scenarios and in order to prevent a repeat of another Swissair 111 total loss scenario. Until such time as FAA adopt said recommendations, the inherent material flammability risks warrant that attention is focused on optimizing the means available to confront a smoke/odour/fire situation.

31. It should also be noted that The National Transportation Safety Board (NTSB) has recommended that a pilot should be able to see out of a smoke-filled cockpit. The NTSB acknowledged the "smoke in the cockpit" problem after investigating the May 1996 fatal crash of ValuJet 592 in the Florida Everglades. The NTSB concluded in its final report of that accident that "emergency cockpit vision devices might have potential safety benefits in some circumstances." The Board formally recommended (A-97-61) that the FAA evaluate "the cockpit emergency vision technology and take action as appropriate. Indeed as long ago as 1956, the Airline Pilots Association (ALPA) requested that the Civil Aeronautics ("Proposed Agenda for the 1956 Annual Airworthiness Review." Civil Air Regulation Draft Release No. 56-9 - April 16, 1956) address the issue of "heavy dense smoke" in the cockpit.

32. <u>Extracts from Probability Analysis (Based in part on AC 120-42A Appendix 1 – Paul Halfpenny)</u>

    a. "To directly compare the hazard of a smoke caused diversion with that of an ETOPS ditching or accident, the probability of a crash as a result of the cockpit smoke can be calculated using FAA guidelines for probability of an event. To reach the lower limit of extremely remote probability (1 x10-7) the probability of the smoke induced diversion causing the second failure, the crash, must be combined with the incident probability. The total probability of the two events, smoke in the cockpit and eventual crash must reach 1 x 10-7 to 1 x 10-9. The calculations have been based on a per hour exposure in accord with the FAA guidelines. Given that the probability of event A, (PA) smoke in the cockpit, is 4.4 x 10-5, to find the probability of event B, (PB,), subsequent loss of the aircraft, which when combined will equal PAB, (1 x 10-7) we divide PAB by PB. Thus (1 x107)/(4.4 x 10-5) = 2.27 x 10-3. The lower probability of 1 x 10-9 when divided by PB yields 2.27 x 10-5. These inferred probabilities of a subsequent loss of aircraft due to cockpit smoke fall in the range of Frequent (2.27 x 10-3) to Reasonably Probable (2.27 x 10-5) (Ref)"

33. When FAA data specific to ETOPS type aircraft is analyzed, it identifies smoke as a leading cause of diversions. A 2003 report on emergency and unscheduled landings of ETOPS class aircraft concluded that smoke was the second most frequent cause of emergency landings accounting for 20% of diversions. The study concluded that these aircraft are twice as likely to make an unscheduled or emergency landing for smoke as for engine problems. (LROPS Unscheduled Landings Analysis, Jim Shaw)

34. Extracts from EROPS and Unscheduled Landings (Captain Jim Shaw)

    a. "When looking only at cruise operations the percentage for "Smoke" conditions leading to an unscheduled landing increases to 20.3% of the events."

    b. "A majority of smoke related events occur during cruise. Fully 54% of all smoke events that cause an unscheduled landing occur during cruise."

    c. "During cruise operations "Smoke" is more than twice as likely to cause an unscheduled landing than an engine problem."

35. The NTSB recommended modification of cockpit smoke procedures to include emphasis on land immediately. (NTSB Safety Recommendation 1-4-2002)

36. The NTSB recommended specific evaluation of cockpit emergency vision systems. (NTSB Safety Recommendation A-97-61)

37. Assure the Flight Crew ability to see and perform duties in the presence of smoke. A Morten Beyer and Agnew report concluded that present standards for smoke elimination and training were inadequate. (MBA report)

38. The Airlines Pilots Assoc. expressed concern in 1992 with regard to the lack of a specific requirement concerning cockpit smoke (ALPA comment AC 25-9a)

39. We conclude that:

    a. The crew must stay focused on fire suppression - the source.
    b. Cockpit smoke becomes the primary focus of crew attention during fires.
    c. ETOPS operations increase the risk of cockpit smoke becoming a survivability factor.
    d. Most fires are not controllable or accessible by the crew. Fires may be hidden, of unknown origin or inaccessible due to the legal requirement for both pilots to remain at their station and on oxygen.
    e. The present disparities in respect of material flammability standards increase the likelihood of an increase in smoke/odour/fire scenarios.
    f. Smoke is a leading cause of diversions.
    g. Smoke is a statistical risk for causing crew incapacitation.
    h. Crew smoke protection should be required for at least 180+ minutes ETOPS operations.

Section 6 - Observations Drawing Upon Post 11 Sep 01 Security Developments

40. Because of post 911 security requirements, additional avionics and security measures are being incorporated in aircraft. Inflight entertainment and passenger communications

systems are also being enhanced (and might be swapped out two to four times during the life of an aircraft within a particular airline's service). Avionics are constantly being enhanced or upgraded. All of these changes are subject to STC and Complex STC action, however they tend to keep an airplane's electrical modification status in a state of flux and because of that (and the large scale of IFE changes in particular) would increase the likelihood of an electrical mishap and smoke/fire event during an ETOPS flight. Because of their controllability concerns, pilots may also prematurely decide to ditch (whether later found warranted or not) if visibility was deteriorating markedly. That scenario could also be brought about by passenger panic. That type of event deterioration is peculiar to fire – and would not be encountered during an engine-failure initiated ETOPS diversion (say).

Section 7 - Proposed Applied Research Projects:

41. We propose the following applied research projects:

    a. Evaluate emerging detection technologies
    b. Evaluate supplemental crew O2 supplies

Section 8 – Mitigation Measures

42. The reliability of fire detectors in cargo compartments should meet the same standards of performance as engines and other critical components. (Conference on Automatic Fire Detection – March, 2001 Proceedings. National Institute of Standards and Technology - Aircraft Cargo Fire and Nuisance Alarms)

43. The crew should have a readily available supply of breathable air for use during prolonged period of smoke and vapor contamination.

44. The rule should take the same "fix all problems approach" by addressing in-service experience with smoke-related events and the identification of appropriate corrective actions to prevent problems that could have an adverse effect on ETOPS Safety Reliability and dependability.

Section 9 - Other Considerations—Future Technology

45. Current smoke detectors are unable to differentiate between smoke, dust, pollen or other large particles. As the sensitivity of current detectors is increased, so is the likelihood of false alarms. As the technology becomes available, Incipient Fire Detection (namely, the ability to alert the flight crew well prior to presence of smoke) should eventually be considered. (ACY Test Center Report). The flight-crew needs the ability to confirm or invalidate an alarm from a smoke detector. This vital information is important for three reasons:

    1. **ANTICIPATING FIRE.** As components heat up, sub-micron particles are emitted long before combustion takes place. Detectors can be developed that would enable the flight-crew to make informed decisions about the condition of their aircraft by providing time-to-alarm information.
    2. **MONITORING THE RATE-OF-RISE.** A rapidly spreading fire may require a pilot to make a decision on whether to continue the flight or exercise a ditching or crash operation into non-survivable terrain. A slower developing fire may enable continuation to a diversion location.

3. **VERIFY STATUS OF FIRE.** Following fire-fighting steps such as de-powering electrical systems or discharge of suppressant, it is currently not possible for the flight-crew to determine the status of the fire as trapped smoke may continue to indicate an alarm condition.

46. Consider a Design Innovation of Enabling a redirection "dump" of all engine and APU fire extinguishants into a cargo-hold fire. This would be a backup to the case where Halon timed suppression was ineffective because of fuselage penetration (uncontained engine failure) or burnthrough.

47. In order for airlines to exercise positive operational control and enable definitive accident investigation, consider requiring Air to Ground Telemetry Data Link of essential aircraft condition monitoring data such as incipient smoke detection.

Section 10 - Summary of Benefits/Cost Savings

48. Including *smoke mitigation strategies* in the proposed ETOPS requirements would increase the level of safety and reliability of an operator that decides to conduct ETOPS operations and costly diversions/incidents/accidents could be reduced. Cost discussions regarding smoke detection and breathable air have been omitted due to a lack of standards. In 1993 Former FAA Administrator Thomas C. Richards stated:

    "[t]he approach envisioned by the regulations is that there be a means or procedure to evacuate smoke that may be present in the cockpit, thereby providing an adequate view of the instruments and the outside world."

49. For smoke mitigation a standard has been established and certified equipment is readily available. For example, in 1989 the FAA approved cockpit emergency vision technology under a Supplemental Type Certificate. As of 2003 more than 1500 cockpit emergency vision technology systems are in service worldwide, in a variety of aircraft including a specification to install systems in the more than 45 aircraft operated by the FAA (We also understand that the Canadian Prime Minister's fleet of Challenger executive jets are the only Canadian Forces aircraft scheduled to receive a US$143,000 safety upgrade. The Canadian government has announced it will equip the six VIP jets with the Emergency Vision Assurance Systems - EVAS). We cannot reconcile how such equipment can be installed on said aircraft and yet within the commercial realm the installation of such equipment has not been mandated. Surely the passengers and crew of the 180+min ETOPS aircraft deserve the same degree of protection as has been afforded by the installation of such equipment on said FAA aircraft.

50. Specific cost information related to 180+ ETOPS is included herein.

Section 11 - Costs Savings Unqualified

51. Insofar as detection is concerned, we believe that increased reliability would reduce false warnings and subsequent diversions/incidents/accidents. 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 (Jenkins). 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. The lost opportunity cost would reduce these estimates by $10,000 resulting in a minimum cost of approximately $79,000.

52. 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 $1 million 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.

Section 12 - Cost/savings matrix for proposed rule change – Smoke Mitigation

53. The following cost/savings matrix data was supplied to IASA by EVAS Worldwide Incorporated. We have supplied this data in order to illustrate the cost/savings matrix associated with a readily available technology. Our submission is not restricted to technology solely produced by EVAS Worldwide Incorporated, however, it is made on the basis that this or identical/similar generic technology be installed on 180+ ETOPS aircraft. Accordingly, this data (insofar as it relates to a product produced by EVAS Worldwide Incorporated) is supplied for illustration purposes only.

<u>Solution considered: Cockpit Emergency Vision Technology</u>

- Application: 180+ ETOPS operations.
- Guidelines: FAA estimates that 92 part 121/25 aircraft and 81 part 135 aircraft will operate 180+ ETOPS (table ten herein).
- Industry averages indicate that each aircraft will have seven flight crews.

Item	***Calculation***	***Amount $***
Equipment Cost	$27,900.00 per aircraft x 173	$4,826,700.00
Installation Cost	8 mh x $65.00 x 173	$89,960.00
Initial QC (Handling, manual modification, etc.)	2 mh x $65.00 x 173	$22,490.00
Equipment Maintenance	4 events @ $1,000.00 x 173	$692,000.00
Ongoing QC, handling, and R&R	4 events @ 2.5 mh x $65.00 x 173	$28,112.50
FAA Required Training (1)	1 Crew Hour @ $165.00 x 7 x 173	$199,815.00
FAA Required Training (2)	25 Instructor hour @ $165.00 x 7 x 173	$49,953.75
Equipment and Manuals	$60.00 x 14 x 173 =	$145,320.00
	TOTAL	**$6,054,351.25**

54. A per aircraft cost of $34,996.25 (pre discount) could be used overall.

55. The roughly $6,000,000.00 cost associated does not consider the substantial discounts traditionally earned by Airline Operators. Even at $6m, this amount does not significantly affect the FAA estimated savings to industry of $823,907,000.00; in fact it represents a change of less than 1%. While by no means do we consider $6MM an insignificant amount of money, we do believe that in the context of over $800MM in savings it represents a more than reasonable investment in safety. The simple application of the saving of one hull and its occupants makes the investment even more practical.

Section 13 - Conclusion

56. This commenter does not presume to have the expertise to establish the certification standards, airworthiness procedures or operational criteria necessary to incorporate the above considerations into the rule. However, the data provided supports, in our view, a reconvening of the ETOPS/ARAC and a re-tasking of them to mitigate the risk of smoke-related events during at least 180 +min ETOPS operations. The ARAC has rightly concentrated upon the reliability of engines and inbuilt systems redundancies but an unjustifiable blind eye had been turned towards smoke and fire within the pressure hull. This is hard to rationalize, given the high daily incidence of inflight electrical fire and smoke and the potential for any such incident to assume catastrophic proportions during the time required for an ETOPS diversion. Aircraft involved in long-range ETOPS flights cannot "Land ASAP" – yet that is the avowed industry-wide community solution since Swissair 111 proved the vulnerability of modern aircraft to inflight fire. ETOPS must be seen as an exceptional variation upon that community theme - and treated accordingly.

Respectfully,

Lyn S. Romano

Mrs. Lyn S Romano
Chairman
International Aviation Safety Association (USA)