Revision of rules for ETOPS & LROPS

EXTENDED TWIN-ENGINED AND
LONG RANGE THREE- AND FOUR- ENGINED OPERATIONS

Two views of the airport at Longyearbyen, Spitzberg

With very long-range airplanes such as the A340-500, an increasing number of flights will be conducted far away from regular diversion airports. Alternate airports along new routes like the Polar and Arctic route systems are subject to the most extreme weather conditions and would require special precautions.

Many Aviation Authorities and the International Civil Aviation Organisation (ICAO) consider that on such new routes, existing regulations would be insufficient to maintain the high level of safety achieved on other international operations.

The Joint Aviation Authorities (JAA) were first to undertake a review of the European regulations, soon followed by other countries and the ICAO.

JAA draft rules are available. They were published for public comments and declared technically mature on 25 June 2003. They comprise ETOPS provisions for two-engine airplanes and LROPS provisions for three- and four-engine airplanes with certain specific provisions for business jets. These are the first rules to be published by an Authority.

André Quet
Vice President
Airbus Product Integrity Division

For two-engine airplanes, the emphasis is on engine reliability and means to protect diversions under extreme conditions. For three- and four-engine airplanes, the emphasis is on avoidance of diversions.

For business jets operated as commercial transport, specific regulatory provisions take into account the size of the aircraft and the nature of the operations, in particular the fact that most concerned flights are not scheduled.

On the occasion of the regulatory review, lessons learned from ETOPS and other long-range operations were taken into account. Many service events potentially affecting safety have occurred during ETOPS flights. ETOPS overall safety record is excellent, but these flights have proven to be vulnerable to human errors by maintenance, dispatch and flight crew. Design precautions required by the new rules will address some of the factors involved in these service events. However operators must absolutely adopt or retain the most stringent ETOPS safety policies to maintain the excellent safety record of ETOPS flights.

JAA RULEMAKING PROCESS

The JAA ETOPS / LROPS Regulatory Working Group has nearly completed its task. A finalised Notice of Proposed Amendment (NPA), submitted to the JAA Regulations Director end May 2003 will be published later in 2003. The NPA will modify JAR 21, JAR 25, JAR E and JAR OPS1.

ARAC PROCESS

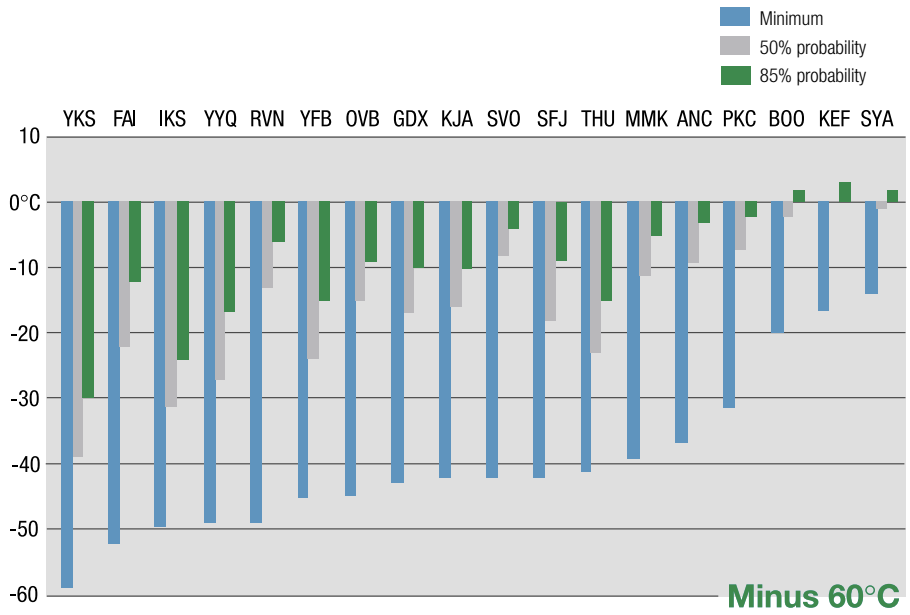
ARAC (Aviation Rule-making and Advisory Committee) has been tasked by the Federal Aviation Administration (FAA) to propose material in view of drafting rules and guidelines for future ETOPS and for other operations with very long diversion time or depending on alternate airports with severe climate and limited infrastructures. All ARAC draft criteria are tentatively grouped under the single name ETOPS, although they deal with two, three and four-engine aircraft including business jets. ARAC draft is now available for use by the FAA to prepare a formal regulatory proposal (NPRM).

ICAO RULEMAKING PROCESS

The ICAO Air Navigation Commission asked the ICAO Operations Panel and Airworthiness Panel to propose revisions to Annex 6 and 8. They jointly tasked a group of experts to draft the necessary material. A State Letter is expected to be ready for review by the Air Navigation Commission in September 2003. ICAO Standards will be effectively modified once the consultation of Member States has shown sufficient support for proposed changes. Once the changes to ICAO Annexes are in place, individual States may decide to deviate from the new Standards and declare a difference or adopt national standards consistent with revised ICAO Annexes.

MORE COUNTRIES ARE PREPARING NEW RULES

Australia, Canada, Hong Kong, New Zealand and Singapore have already announced their intent to review their ETOPS and long-range regulations.



Polar winter temperatures

BASIC REGULATORY PRINCIPLES

All draft rules in preparation will address existing routes as well as new routes. The new routes are longer than most current flights. On such routes, the distance to divert to an airport will be far greater and the available airports, if any, may be located in areas with very severe climate and limited infrastructures such as the Polar areas.

Most two-engine airplanes, even those approved for ETOPS, will not be capable of operating the new routes due to insufficient engine reliability and systems redundancy. Only the most recent engines are reliable enough to conduct such flights with two-engine airplanes. Furthermore the fuel reserves necessary to ensure a safe diversion at low altitude in case of engine failure may make such routes uneconomical for two-engine airplanes.

Three- and four-engine airplanes are much less affected by this problem. Three and four-engine airplanes have been safely flown on routes with very severe conditions, although not as extreme as what is contemplated now.

Even airplanes with an old design have an excellent safety record on these routes. Higher system redundancy and operational capability (such as the capability to fly safely with two engines failed) are essential on the extreme routes.

OPERATIONAL SAFETY ON THE NEW EXTREME ROUTES

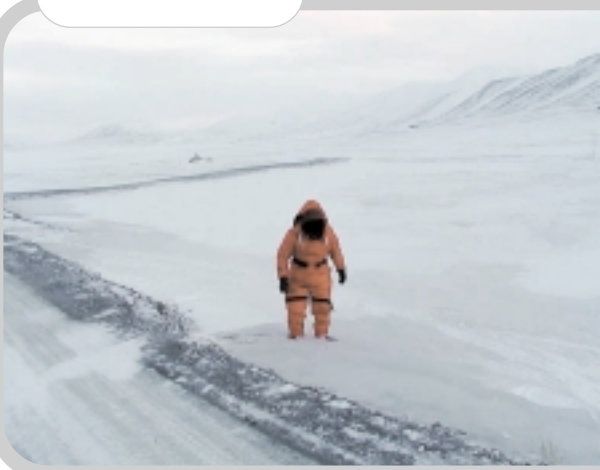
To maintain the intended level of safety when operating the new routes one may either design to avoid diversions or adopt operational precautions to protect the safe conduct of diversions.

Protecting the safe conduct of diversions will typically be the solution for operators of two-engine airplanes who have to divert to the nearest airport in case of engine failure. They will have to implement and validate a Passengers' Recovery Plan to ensure the safety of all occupants in case of diversion followed by an evacuation at airports in severe climate areas. The Recovery Plan may need survival equipment carried onboard the airplane for use at airports in the Polar areas. It may also require investments in airport facilities – Search and Rescue (SAR) services, medical services, snow removal, shelters, ground transports, etc – for the protection of evacuees.

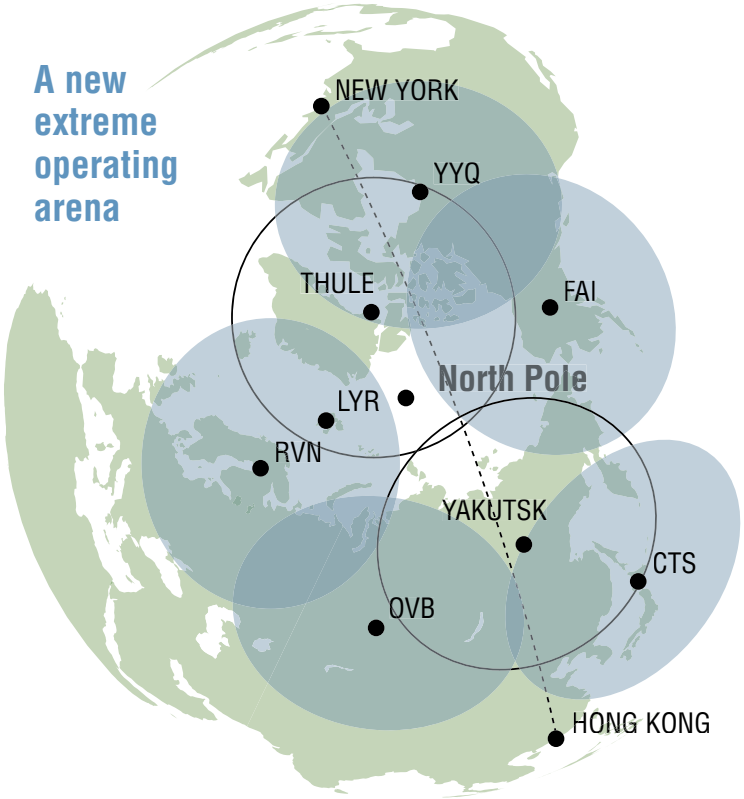
Operators of three and four-engine airplanes do not need to divert to the nearest airport in case of engine failure. Other causes of diversion may be designed-out or minimised with appropriate technology. In the rare cases when a diversion is needed, its effect may be minimised by design that allows the crew to fly to a more welcoming, althouth more distant airport.

Airbus LROPS design will preclude diversions through specific design features and technology so that the A340 and A380 operators flying the new routes are not penalised by the implementation of costly Passengers' Recovery Plans. The Airbus LROPS package will be made available to A340 and A380 operators when the rules are in place.

A survival suit in action



A new extreme operating arena



Thule and Yakutsk are needed for twin-engine aircraft to stay within 3 hours (at least) from an airport

YYQ - Churchill
FAI - Fairbanks
LYR - Svalbard (Spitzberg)
RVN - Rovaniemi
CTS - Sapporo-New Chitose
OVB - Novosibirsk/Tolmachevo

KEY FEATURES OF FUTURE ETOPS AND LROPS RULES

FUEL RESERVES

For two-engine airplanes, the ETOPS fuel reserves (critical fuel scenario) should no longer be calculated with current conservative margins covering the worst possible combination of adverse operational contingencies. New lower ETOPS fuel reserves will decrease the economic burden on ETOPS operators but require closer crew monitoring of the fuel situation during the flight. New sophisticated fuel alerts (only on new aircraft) should compensate for this change.

Fuel reserves of three and four-engine airplanes are not affected by the failure of one or even two engines. However conducting a diversion with a depressurised cabin may require more fuel than the normal route reserves if the diversion time from the critical point of the route is very long. The possibility for airplanes fitted with new technology oxygen systems to perform a depressurised diversion at a higher altitude will overcome this economic penalty.

PLANNING MINIMA

Conservative planning minima for en-route alternate airports remain in place for ETOPS. Two-engine airplanes do not retain precision approach capability in some of the degraded system configurations that may exist during a diversion (e.g. in case of electrical emergency). For this reason, their planning minima may not benefit from a reduction.

Three and four-engine airplanes operated over LROPS routes should also apply a system of planning minima at diversion airports. However three and four-engine airplanes normally retain Category II Autoland capability in all the degraded system configuration cases that may lead to a diversion. Their planning minima will therefore be much lower than those of two-engine airplanes. This will be the case of Airbus A340 and A380.

RECOVERY PLAN

Implementing a Recovery Plan at designated alternate airports in Polar areas (and other areas with severe weather) is a completely new requirement with far reaching implications. Under the new rules, concerned operators will have to ensure the safety of all occupants until they are eventually flown to a commercial airport. This concerns all aspects of the occupants' wellbeing during the diversion and on the ground, including the worst-case scenario of an evacuation under Polar weather conditions. Recovery Plans will require specific training for flight crew and cabin crew to cope with very cold temperature and wind chilling effect issues during an evacuation. Individual survival kits may be needed. Airport safety services (SAR and RFFS) are a key part of the Recovery Plan.

Operators are normally required to perform a demonstration of their Recovery Plan at alternate airports selected by the Authority. However, airplanes certified with the capability to operate safely for very

long diversion time may designate other more distant alternate airports and achieve excellent operational results while avoiding costly Recovery Plans, provided crew procedures do not require diversion to the nearest airport. This is the certification objective for Airbus A340 and A380 LROPS technology package.

DIVERSION TIME LIMITED BY THE CAPACITY OF TIME-DEPENDENT SYSTEMS

The maximum diversion time of all airplanes approved for LROPS and for ETOPS beyond 180-minute diversion time should be limited by the certified capacity of any time-dependent function. The cargo fire suppression time, or any other time limit in a critical system will appear as certified limitations in the Flight Manual resulting in diversion time limits after application of appropriate operational margins.

These limitations will normally apply at the one engine inoperative speed. However in the case of cargo fire suppression, the limit will be applied to the all-engine operating speed. Diversion time limits above 180 minutes will not be applied as fixed distance limits in still air and ISA conditions as in current ETOPS criteria, but as real time limits under the day's forecast wind and temperature conditions.

DESIGN CRITERIA ORIGINATING FROM LESSONS LEARNED

Service experience has shown greater vulnerability of ETOPS to particular human error scenarios. The most serious events have resulted in both engines shutting down (either temporarily or permanently). They involved line-maintenance errors, servicing errors, errors during the application of the pre-departure ETOPS service check, errors in fuel planning or fuel management, etc. A number of system-related events were also observed, including a total electrical failure, multiple hydraulic failures and multiple air bleed failures.

Survival suits – ready to wear

Future rules will impose design solutions that have proven more robust against known human error scenarios:

- Demonstration of engine operation without flameout in suction feed configuration.
- "Smart" fuel alerts detecting potential fuel shortage situations before they can affect flight completion or a safe diversion.
- More comprehensive list of electrical services available in back-up electrical configuration and higher integrity of the electrical generating systems.
- Higher integrity of the air-bleed sources including the APU.

Although these requirements are driven by ETOPS service experience, some of them may become useful improvements for three and four-engine airplanes and have been retained as LROPS requirements by the JAA.

Emergency landing

Landing strip in foothills of the Himalayas

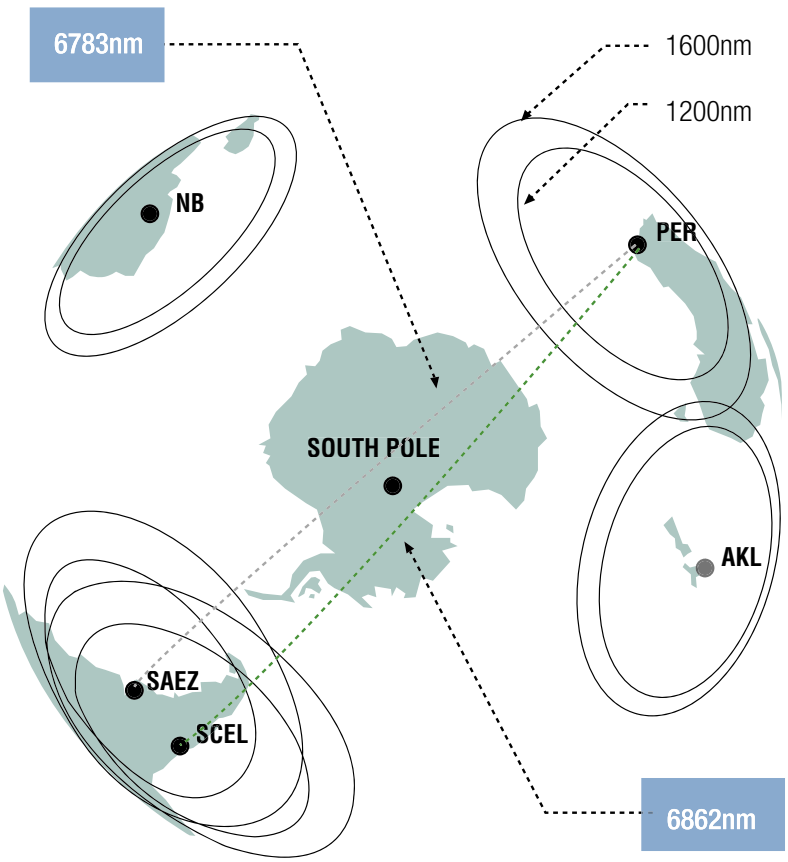
APPLICABILITY OF NEW RULES – GRAND FATHER CLAUSES

The conditions of application of new rules to existing airplanes may have a significant economic impact on operators flying the Siberian routes and other long routes over the Pacific. Compliance with the operational criteria in the case of airplanes not designed to the new rules may lead to increased cost. Discussions are continuing regarding the cost of applying proposed rules to existing airplanes. Three and four-engine airplanes of an older design might be unable to comply with proposed rules at an acceptable cost, requiring some form of dispensation. The design of Airbus A340 is essentially compliant with proposed rules and should not need significant retrofit action.

Two-engine airplanes would inevitably have to comply with the new rules in case of flight beyond 180-minute diversion time, but retroactive application to other ETOPS flights is still a matter of discussion between the Aviation Authorities.

Unlimited extended range

8 hours diversion time



TWO-ENGINE AIRPLANES

- Existing two-engine airplanes up to 180 minute diversion time
- Existing two-engine airplanes beyond 180 minute diversion time
- Future two-engine airplanes

THREE- AND FOUR-ENGINE AIRPLANES

- Already certified three- and four-engine airplanes
- Voluntary compliance with three- and four-engine airplanes
- Three- and four-engine airplanes on routes over high terrain
- Future three- and four-engine airplanes

BUSINESS JETS ENGAGED IN COMMERCIAL OPERATIONS

CONDITIONS OF APPLICABILITY OF THE NEW RULES

Two-engine airplanes currently approved for ETOPS up to 180 minute diversion time should not be subject to new design requirements and should therefore require no retrofit action as long as they continue to be operated below their currently approved maximum diversion time. However the legal means to transform current Operational Approvals into "Certifications" have yet to be defined by concerned Aviation Authorities. Concerned operators may benefit from some or all of the changes of the operational requirements resulting in some improvement of their ETOPS operating cost, in particular from a reduction of the ETOPS fuel reserves.

Once the new rules are finalised and adopted, two-engine airplanes with highly reliable engines may become eligible for ETOPS flights beyond 180 minute diversion time if they are modified to achieve compliance with all the necessary design and operational provisions. The main hardware changes will concern time-limited systems such as cargo fire suppression, fuel alerts, electrical generating systems, pressurisation, fuel-feed to the engines and of course engine reliability. The main operational changes will concern retention of engine reliability and the implementation of a Passengers' Recovery Plan.

Future airplane types will have to comply with all aspects of the new rules.

On most existing routes, the proposed rules should not affect three- and four-engine airplanes because of the 180 minute rule threshold. For routes with more than 180 minutes diversion time (North and South Pacific ocean, South Atlantic, South Indian Ocean and South Pole routes), the impact of proposed rules will be different for A340 and for other three- and four-engine airplanes of an older design.

The only design provision clearly considered as retroactively applicable by all involved Aviation Authorities concerns cargo fire suppression systems. A340 operators who will need more than four hours of protection time (basic A340 protection complement) may need to install larger capacity cargo fire extinguishing bottles.

JAA operational rules should affect the calculation of the fuel reserves. Current ICAO rules (Annex 6) reflected by all countries in their national operational rules require that any airplane carry enough fuel to complete a depressurised diversion. Proposed rules should impose a check of the weather at the alternates used in this calculation, but only if the diversion time exceeds 180 minutes. The planning minima applicable to the en-route alternates should be lower than those of two-engine airplanes as four-engine airplanes normally retain full Category II Autoland capability in all degraded system configurations leading to a diversion. Proposed rules should also require consideration of forecast icing conditions in the fuel calculation. Conversely, the proposal should allow calculating the fuel reserves at a diversion altitude higher than 10,000ft if there is enough oxygen available. Airbus LROPS design will take full advantage of this possibility.

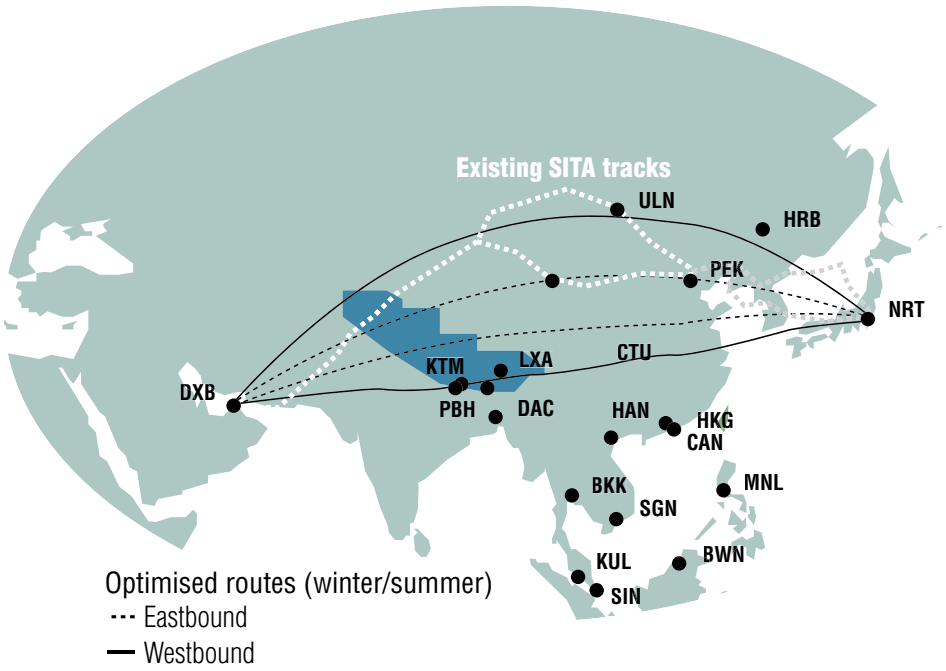
Three- and four-engine airplanes operated on routes with very long diversion time and/or over areas with airports subject to severe weather may benefit from voluntary compliance with the new rules if LROPS technology is available from the manufacturer to draw maximum advantage from the new rules. Airbus will make LROPS technology available for retrofit on all A340 to achieve economic gains via optimised fuel reserves and a drastic decrease of the number of diversions made possible by this technology.

Under current rules, routes over high terrain (higher than the two-engines-out net ceiling of the airplane) are only permitted where alternate airports are available within 90 minute flying time. This limitation has constrained the opening of direct routes over high terrain areas such as the Himalayas and Tibet plateau or the Antarctic. Outstanding engine reliability of modern four-engine airplanes opens the way for a revision of this rule so that quads are treated the same as twins, letting them operate based on the extremely low probability of a double engine failure. This possibility already exists in ICAO Annex 6, but has never been used, as engine reliability was not sufficient. Work is in progress with JAA on this subject.

Future airplane types will have to comply with all aspects of the new rules.

All future rules should contain specific provisions applicable only to business jets. These provisions will be governed by the size of the airplane (with an upper limit of 19 passengers) and by the type of operation (on-demand flights only). JAA proposes an intermediate step of approval at 120 minutes diversion time for two-engine business jets and a more complete set of criteria beyond 180 minutes. Two-engine business jets are treated separately from three- and four-engine business jets for the same reasons as larger aircraft.

Routes over the Himalayas



LROPS TECHNOLOGY

Airbus LROPS technology is aimed at:

- Reducing the number of cruise diversions.
- Protecting the possibility to conduct safe diversions to distant airports with better weather and infrastructures, and therefore not subject to a Passenger Recovery Plan.
- Improving the economics of LROPS by optimised fuel reserves.

Airbus LROPS technology concerns all systems that may present failures leading to a diversion or affecting the safety of diversions. Although some elements of LROPS technology may also be successfully implemented on two-engine airplanes, most features require the superior redundancy and system capability of four-engine airplanes.

Conclusion

Airbus is committed to the implementation of technology that will avoid diversions and optimise fuel reserves. Airbus considers this approach as most effective to maintain and further improve operational safety over the new very long routes.

A340 airplanes already in service essentially comply with the draft rules. Further product improvements will be made available to operators to maximise safety, operational flexibility and economics under the new regulatory environment.

Airbus LROPS design is optimised to draw maximum benefits from JAA LROPS criteria when they become effective. However, A340 and A380 will be also certified to other ETOPS/LROPS rules as necessary. The Type Design criteria prepared by JAA and ICAO as well as those drafted by ARAC are technically similar and the final rules should be no obstacle to the validation of Certificates between concerned countries. Draft Operational Criteria differ on many key aspects. Depending on the operators' fleet, operating policies and route network, the economic impact of the new rules may be substantially different. The revision of ETOPS rules and the implementation of LROPS rules will have a significant impact on the safety and economics of very long flights; especially those conducted in areas with severe operating environment. Operators interested in such flights should imperatively seek participation in the rulemaking process of their country. Airbus recommends that they follow any formal regulatory consultations and adopt a proactive attitude towards the national rulemaking process of their country with attention to the elements that have the more economic impact.

Examples of potential regulatory concern are applicability of new rules to existing operations and existing airplanes, criteria for the calculation of fuel reserves, criteria for the choice of alternate airports and implementation of a recovery plan, diversion time limitations not driven by airplane certified capability or any other criteria that may penalise current or future operation.

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