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OFFICE OF THE CHIEF COUNSEL RULES DOCKET

BOEING

Federal Aviation Administration
Office of Chief Counsel
Rules Docket Office (29547)
800 Independence Avenue, SW
Room 915-G
Washington DC
20591

Subject: Docket number 29547: 207 Minute Extended Range Operations with Two-Engine Aircraft (ETOPS) Operation Approval Criteria

Enclosed please find an additional submittal to the docket. While we are aware the stated period of time for such submittals has passed we are hopeful you will accept and fully consider our comments.

Very truly yours,

C. L. Ekstrand

Enclosures

Additional Boeing Observations

Boeing has had an opportunity to review the comments received by the FAA during the comment period for 207 Minute ETOPS (Docket No. 29547). In our view, many of the comments are not germane to 207 minutes in the North Pacific. Additionally, some of the comments include inaccuracies about Boeing airplanes, factual errors or misrepresentations. Boeing submits the following for purposes of clarification and accuracy.

ETOPS airplane certification limitations

The comments submitted in docket reference number (11) include the incorrect statement that, "...as part of the certification process, ETOPS maximum diversion time limitations are imposed on aircraft by FAA. The B-777 aircraft has, for example, been limited to 180-minute extended range operations, according to Type Certificate Data Sheet T00001SE, note 7."

Note 5 of Type Certificate Data Sheet T00001SE (which is the one addressing ETOPS) states, "The Model 777-200 and 777-300 airplanes have been *evaluated* in accordance with FAA Special Conditions Number 25-ANM-84, and *found suitable for* 180-minute Extended Range Operations with Two-Engine Airplanes (ETOPS) operations...." Thus, the Type Certificate Data Sheet states that the 777 is *suited* to 180-minute ETOPS, but it does not indicate a *limitation* to 180-minute ETOPS.

The 767 is also suited for but not limited to 180-minute ETOPS. Type Certificate Data Sheet A1NM (767 family) states in Note 7, "The type design reliability and performance of this airplane has been ***evaluated*** in accordance with FAA Advisory Circular 120-42A and ***found suitable for extended range operations*** when configured in accordance with Boeing Document D6T11604 'CONFIGURATION, MAINTENANCE AND PROCEDURES FOR EXTENDED RANGE (ER) OPERATIONS'."

In turn, the referenced 767 CMP document states, "This document presents the Model 767 airplane configuration, maintenance and procedure standards for extended range operations (ETOPS) up to 180 minutes of diversion time from an alternate airport. Upon incorporation of these standards, type design of the Model 767 is found to *be suitable for* ETOPS operation in accordance with the provisions of FAA Advisory Circular (AC) 120-42 or AC 120-42A, as applicable."

Likewise, the 777 and 767 Airplane Flight Manuals also do not include any restrictions on ETOPS diversion times in the 'Limitations' section (Section 1). "Normal Procedures' (Section 3) of the 777 AFM states, "The type design reliability and performance of this airplane/engine combination has been evaluated in accordance with 25-ANM-84 FAA Special Condition: "EXTENDED RANGE OPERATIONS OF BOEING MODEL 777 SERIES AIRPLANE," dated July 1, 1994, and ***found*** *suitable for extended range* ***opera-***

tions. 'Normal Procedures' (Section 3) of the 767 AFM states, "The type design reliability and performance of this airplane/engine combination has been evaluated in accordance with FAA Advisory Circular 120-42A and *found suitable for extended range operations* when configured in accordance with [the Boeing 767 CMP]."

Therefore, it is incorrect to say that the 777 is limited by FAA certification to a maximum diversion time of 180 minutes. Supporting pages from all the above-referenced FAA approved documents are enclosed at the rear of this document (Enclosure A).

North Atlantic and North Pacific ETOPS Operating Environments

In AC 120-42 and AC 120-42A, the FAA recognizes just two types of ETOPS operating environments: *benign* and *demanding.* The Caribbean is considered a benign ETOPS operating environment. The North Atlantic is given as an example of a demanding ETOPS operating environment.

One commenter (11) appears to attempt to alter this FAA characterization of ETOPS operating environments. The commenter's submittal contrasts the "relatively benign" North Atlantic with the "significantly more harsh environment" of the "remote and demanding" North Pacific. The North Atlantic "is relatively more generally forgiving," the commenter writes, whereas the "North Pacific area of operations imposes far more severe demands, especially in winter." As shown below, however, these two ETOPS environments are similar.

Alternate Airports

The North Pacific has about the same number of alternate airports as the North Atlantic, where ETOPS has been flown since 1985 (see Figure 1 on Page 16). Out of the seven or eight (depending on the type of airplane used, airline preferences) alternate airports available between Anchorage and Sapporo, just one is needed to fly the Pacific under 180-minute ETOPS rules. In fact, one Canadian airline performs non-ETOPS twinjet operations across the Pacific under special authorization from its regulatory agency that permits it to span the very small gap of a few minutes' flying time separating the 60-minute diversion radii of two of its en route airports.

Boeing and airlines have visited and assessed North Pacific alternate airports to be sure that they are adequate. *AC* 120-42A requires airlines to ensure the airports are adequate before they list them as enroute alternates..

Extreme temperatures

A chart in the comments submitted under docket reference number (10) shows "winter temperatures at alternate airports ." The chart includes airports like Yakutsk, Tiksi, Novosibirsk, Murmansk, Rovaniemi, and some other airports which are not even North Pacific alternate airports. This commenter further asserts, "The US National Climatic Data

Center lacks recent data for Shemya (no data since 1995)." In fact, Shemya data is available online as illustrated by the enclosed example showing current weather for 6/17/99 at 2032Z (Enclosure B). The commenter (11) submittal also states, "....and present criteria for alternate airports do not address the extreme winter conditions found at high latitudes." Table 1 (immediately below) shows that most of the alternates used for North Pacific operations (with the exception of Anadyr) are actually situated *south of Anchorage*, while Anadyr lies at approximately the same latitude as Iqaluit, an airport commonly relied upon in North Atlantic operations.

North Pacific Airport	Latitude	North Atlantic Airport	Latitude
Adak	51°53'N	Iqaluit	63°45'N
Anadyr	64°44'N	Kangerlussuaq	67°01'N
Anchorage	61°10'N	Keflavik	63°59'N
Cold Bay	55°12'N	Narsarsuaq	61°10'N
King Salmon	58°41'N	Shannon	52°42'N
Petropavlovsk	53°10N	Yellowknife	62°28'N

Table 1

The same commenter states that, "Without adequate facilities for passenger accommodation, evacuees simply could not survive the winter temperatures commonly experienced at Siberian airports, which can easily range from -30 to -50°F. However, as noted above, **Siberian airports do not serve as alternate en routs airports for the North Pacific region.**

Elsewhere the same commenter says, "the typical winds on winter routes drive aircraft to high latitudes, where diversion airports with good facilities to accommodate aircraft and passengers do not exist, and winter temperatures on the ground are dangerously low. (Ironically, the low-latitude summer routes dictated by ETOPS constraints lead one to rely on Midway airport, which has a serious bird problem which is worst during that season.)"

In fact, however, North Pacific alternate airports **lie south of the Arctic Circle.** While some alternates are better equipped than others, based on our survey of these alternates in the North Pacific, it is misleading and incorrect to assert, as the commenter does above, that "good facilities... do not exist" in this region. As for Midway, its "serious bird problem" doesn't prevent business jets from routinely using it. Although diversions are very rare events, commercial jetliners (three- and four-engine airplanes included) have and will continue to use Midway for this purpose when needed.

Furthermore, because 207-minute ETOPS will be flown on a flight-by-flight exception basis, airlines will exercise 207-minute authority only on routes that they can already fly under 180-minute rules. Therefore, **airlines will be relying on the same alternate airports *for* 207-minute ETOPS that they normally use for 180-minute ETOPS,** so most of these issues raised regarding airport temperatures and region of operation are irrelevant to the 207-minute policy issue.

Mission Lengths and Average Diversion Times

One commenter (11) asserts that "the vast distances of travel in the Pacific area give rise... not only to much longer travel times than those common in the Atlantic, but to very much longer average and maximum diversion times." While route lengths are generally longer across the Pacific than the Atlantic, however, it does not follow that longer routes mean ETOPS twinjets will necessarily find themselves farther away from an alternate airport in the event a diversion becomes necessary. Whether over the North Atlantic or the North Pacific-and regardless of how long the route is that's being flown-a twinjet flying 180 minute ETOPS by definition remains within 180 minutes' flying time (at single-engine cruise speed) of one or more suitable alternate airports throughout its flight.

The same commenter also says, "Associated with these flights are typical (not maximum) diversion times (including considerations of typical actual temperature and winds) of 75 minutes in the North Atlantic [and] 160 minutes in the North Pacific." Since the North Pacific has about the same number of en route alternate airports as the North Atlantic, it is not clear how the commenter can make such an assertion, Arriving at this conclusion appears to require that some of the available North Pacific alternates be deliberately ignored.

In all likelihood, because 207-minute ETOPS allows some flights to be shorter and more direct, it should enable airlines to dispatch airplanes on more-direct routes that probably stay closer to a number of suitable alternate airports en route. It might also be noted that there has never been an ETOPS diversion of even 180 minutes' duration. **In the entire history of commercial jet travel, Boeing cannot identify a single instance of an emergency diversion of 180 minutes or greater to an alternate airport by <u>any</u> airplane, regardless of how many engines it has,**

The same commenter suggests that this will change now that twinjets are operating in the North Pacific. However, ***four-engine jetliners have been operating in this region since the 707 introduced nonstop*** *transpacific* ***air travel in the early 1960s.*** Despite nearly four decades of nonstop North Pacific air travel-much of it by early-generation jetliners with their far lower levels of reliability-not one instance is known to us of an emergency diversion of 180 minutes or greater to an alternate airport.

Diversions and safety

Diversions to unscheduled landings are exceedingly rare. All airplanes can divert due to reasons that include passenger illness, turbulence, fuel leaks, decompression, cargo fires, or system failures, such as engine failure. North Pacific alternate airports play an important role in the safety of *all* commercial aviation in the region. Their availability is at least as important to four-engine operators, since four-engine airplanes demonstrate higher diversion rates, engine related and otherwise, than do twinjets.

The same commenter observes that in the event of an inflight shutdown (IFSD) twins are required to divert to the nearest alternate airport, whereas there is no regulatory requirement of three- and four-engine airplanes to do so. However, the flight crews of three- and four-engine airplanes often do so in any event on a precautionary basis (policies vary from airline to airline as to whether and when to divert). It should be noted that fewer than 10% of Boeing twinjet diversions in recent times are the result of IFSD, but rather of factors that may affect any airplane. Out of the last 267,000 ETOPS flights by 767s and 777s (12 months ending March 1999), for example, just two engine-related diversions occurred during the ETOPS portion of flight.

Modern jetliners are enormously safe, regardless of number of engines. ETOPS twins demonstrate a lower rate of engine-related diversions-and diversions for any reason— than three- or four-engine airplanes. Modem ETOPS twins such as the 757, 767 and 777 have remarkably low hull loss accident rates, which are typically significantly below the rates of the three and four-engine airplanes they replace. In addition, their propulsion system related hull loss accident rates and diversion related accident rates are also lower. In short, a vast amount of industry data (including 1.5 million ETOPS flights by Boeing and other twinjets) shows ETOPS have contributed positively to the safety of long-range flight.

Engine Failure Probability Assessment

One commenter (10) in its comments (item 4, paragraph 3) characterizes as "a 'hazardous' event" an ETOPS diversion in the North Pacific to an adequate airport that the airlines prior to airplane dispatch have deemed "suitable" (as defined in AC 120-42A). This commenter's assertion is totally inappropriate. There is no precedent for classifying as 'hazardous a diversion to a suitable alternate airport. Single-engine cruise is, in fact, not an emergency situation, but rather a planned and certified capability of twin-engine jetliners. Moreover, the functional hazard assessments associated with the numerical probability analyses were conducted considering all aspects of the ETOPS mission including the extension of maximum diversion duration from 180 to 207 minutes. It must also be observed that the North Pacific's designated alternate airports have been surveyed and deemed acceptable by the airlines themselves.

The same commenter further asserts (item 4, paragraph 4) that, "The engine that served as a reference for the original ETOPS criteria was the most reliable engine in the world fifteen years ago. It only had a rate of in-flight shut downs (IFSD) of .05 per 1000 engine operating hours. This corresponds to a probability of diversion of 1 per 10,000 hours and to a probability of double engine failure of 8×10^{-9} per flight hour, both well in excess of the FAR 25.1309 requirements."

The commenter's assertion is wrong. The original ICAO dual engine failure risk model was proposed by the CAA and the requirement set as $(0.6+0.4T) \times 10^{-8}$ per aircraft flight hour where T was flight duration (i.e. at T= 1 hour the requirement was 1E-8 per aircraft flight hour). The requirements of FAR 25.1309 were not employed in the discussion. The risk model was based on actual accident rates by aircraft model and factored to be 1% of that rate.

The CAA model produced a required in flight shutdown rate of 0.05 per 1000 engine hours for 120 minute diversions. The reliability of a number of engines in commercial aircraft service were better than the requirement and a few engine models had IFSD rates that were higher. The JT8D engine had a rate that was significantly better than the 0.05 requirement, When ETOPS was extended to 180 Minutes the then current 0.02 per 1000 engine flight hours IFSD rate of the JT8D was brought into the argument for the requirement without reference to any probabilistic formula or model.

While JAR 25.901(C) states that " The powerplant installation must comply with JAR 25.1309; this requirement has not been used by the FAA with relation to the risk of dual engine failures for ETOPS.

Usc of ICAO Formula for Calculating Dual Engine Failure Probability

The formula quoted by the commenter (10) appears to be incorrect by a factor of 2 greater than the formula derived from the ICAO equation for the risk of dual engine failure due to independent causes,

The same commenter also compares this ICAO-derived formula for IFSD rate with FAR 25.1309 requirements. The ICAO equation for risk is not part of the FAR 25.1309 requirement. The derivation of the ICAO formula is well documented. There has been no proposal or agreement on the derivation of a probability analysis for compliance with FAR 25.1309 (i.e., the exact form of the probability equation, the assumptions made, or the metrics used as input). AS previously stated, Propulsion failures are subject to separate regulations (FAR 25.901 and 25.903). Therefore, a valid conclusion cannot be reached that today's IFSD rates do not meet the FAR 25.1309 requirements.

The commeter incorrectly concludes that 207 minute ETOPS would reduce today's level of safety to that of 15 years ago. The ICAO formula in its current form provides an IFSD rate of 0.019 for 207-minute diversions. The 0.019 rate for 207 minute diversions results in safety margins that are consistent with 180-minute ETOPS operation at an 0.020 IFSD rate. The risk for a fleet operating 207-minute ETOPS is less than that incurred by fleets operating at a 0.05 IFSD rate for 120-minute ETOPS. Therefore, the small increase in average diversion time for 207 minutes ETOPS will result in a level of safety equivalent to that required for today's 180 minute ETOPS.

Boeing recognizes that IFSD rates have improved since the inception of the ETOPS IFSD-rate requirements. ETOPS IFSD rates in the industry have outperformed the minimum requirements set by the FAA. There is every reason to believe the industry will continue to improve the reliability rates of engines while an acceptable maximum IFSD rate limit consistent with past ETOPS operations is in place. We expect the overall fleet IFSD rates to continue to improve as the industry demands and provides ever-increasing levels of reliability. We also recognize that the existing reliability and safety requirements imposed on the industry have provided 14 years of exemplary performance. In short, we can find no justification for an arbitrary restriction on the currently allowed safety margins.

Concerns About PSRAB and ETOPS CMP

One commenter (10) states that it "has an additional concern with a policy implemented by the FAA to discontinue the PSRAB process and freeze the contents of the ETOPS CMP document."

In reply, we observe that the FAA's number-one priority is continued airworthiness of the fleet, ETOPS and non-ETOPS. Engine reliability is continuously monitored by the FAA Engine and Propeller Directorate to ensure that engine reliability is acceptable for ETOPS operations. If an unsafe condition is detected in the fleet, whether ETOPS or non-ETOPS, the FAA will take appropriate *airworthiness directive (AD) action to correct the condition. These ADs would not normally be included in an ETOPS CMP because the AD supersedes anything that might be included in a CMP. FAR Part 39, paragraph 3, of course prohibits any person from operating an airplane unless it is in accordance with an applicable AD.

The ETOPS CMP is intended to define a minimum standard that is acceptable by the FAA Administrator for operating of two-engine airplanes beyond 60 minutes from a suitable airport. This process has produced the most reliable engines since the dawn of flight. To quote a previous FAA Associate Administrator, Anthony J. Broderick, "ETOPS is, in my opinion, one of two programs in recent times which have significantly improved aviation safety." (Introductory Remarks - Anthony J. Broderick, FAA Response to Early ETOPS Proposals, Boeing, Seattle: May 16, 1990)

Conflicting Statements from the same commenter About ETOPS Safety

In its comments to FAA Docket No. 29547, one commenter submits contradictory statements regarding ETOPS safety. In its direct submittal (p. 13), commenter (11) endorses today's ETOPS operations in the North Pacific and elsewhere, asserting: "Airbus Industrie agrees with ATA that the existing 180-minute ETOPS authority is adequate for almost all the heavily traveled routes in the world (including, we believe, those that are currently being operated in the North Pacific)."

Yet in its comments submitted through the JAA ETOPS Working Group, the same commenter states: "Airbus Industrie is concerned that North Pacific operations conducted under the current 180-minute rule may already be unsafe and will be aggravated if the proposed policy is adopted, because it will privilege the most northern routings in winter." North American and Asian carriers-including Asiana, EVA, UPS, and Canadian-have flown transpacific 767 ETOPS services for many years. The 777 joined the 767 in transpacific ETOPS in July 1997 with nonstop Guangzhou–Los Angeles services inaugurated by China Southern Airlines. Korean Airlines followed suit with North Pacific

777 ETOPS in February 1998. In November 1998, Continental Airlines initiated nonstop 777 ETOPS services between New York (Newark) and Tokyo (Narita), and subsequently added other transpacific services. American Airlines inaugurated 777 services to Tokyo from Dallas, Seattle, San José, and Chicago in the first half of 1999. Thus, while transpacific ETOPS experience is still limited, it is far from an unknown. It should also be observed that all these carriers believe that (1) there are a sufficient number of alternate airports in the North Pacific, and (2) these airports are adequate for airplane diversions at all times of the year.

207-Minute ETOPS and Weather Minima

One commenter (11) states that it is very concerned by "the implication that 'higher weather minima [required by existing ETOPS guidance material] at dispatch' is one of the factors cited as justification for relaxing the ETOPS criteria." This statement misrepresents the industry's request for 207-minute ETOPS diversion authority, as submitted by the ATA. The ATA request ***includes no request whatsoeverfor relaxation of weather minima*** at ***alternate airports.*** Regardless of whether an airplane flies under 180-minute rules or 207-minute rules, the landing minima (ceiling and RVR) at its alternate airports along its route will be the same.

When planning an ETOPS flight, Advisory Circular 120-42A requires that a conservative weather-related factor be applied. This factor may result in the delay or cancellation of a flight. It may also result in the selection of a longer, less-direct route that remains within 180 minutes of a suitable alternate airport. As the ATA submission observes, however, this conservative weather factor no longer applies once the ETOPS twinjet is airborne. At that time, and throughout the remainder of the flight, the normal landing minima apply at the alternate airports and not the more-conservative weather factor on which dispatch was based. Therefore, a flight crew taking a less direct route to remain within 180 minutes of suitable alternates may actually find they are further away from the nearest suitable alternate airport in the event that an actual diversion is required.

In short, 207-minute ETOPS will not change the conservative weather factor on which ETOPS dispatch is based, nor will it alter or in any way "relax" the landing minima for alternate en route airports. Instead, the industry's need for 207-minute ETOPS is based on operator need for additional flexibility to fly the optimal route. Rather than relaxing existing safety, 207-minute ETOPS may result in airplanes actually being closer to suitable alternate airports in the event that a diversion actually becomes necessary.

Calls for reconsideration of "still air" diversion computations

One commenter (11) correctly observes that, "The proposed approval basis for 207-minute ETOPS authorizations continues to rely on the computation basis, first established by FAA in 1953, of distance traveled at single engine speed ***in*** still ***air."*** However, the commenter adds its belief that, "It is time to reconsider the basis of these computations. The growth of diversion times from 60 minutes in 1953 to the 207-minute maximum proposed today renders obsolete the simplifications necessarily made nearly 50 years ago."

This call by the commenter for reconsideration of existing ETOPS methodology on safety grounds is unwarranted because it overlooks key facts. First, although diversion distances at single-engine flying speed are indeed calculated on the assumption of still air, *fuel loads are* not. Current and forecast winds are taken into account in determining fuel load during dispatch planning. Winds are also taken into consideration during the critical-fuel-scenario analysis that is performed before any new ETOPS or other route is flown. Designed to ensure that sufficient fuel is always available for low-altitude diversions, this analysis assumes a decompression at the worst possible point on the specific route being studied (an engine failure is also assumed if it would further increase fuel consumption). Also assumed are a low-altitude diversion and a letdown at the diversion airport followed by a fifteen-minute hold, a missed approach, and a successful landing. Additional fuel is then factored in for added safety. This process defines the *critical fuel* reserve, which is the smallest fuel load that may legally be carried by ETOPS twinjets on the routes they Serve.

In this way, ETOPS airplanes are assured of ample fuel for a diversion regardless of the wind. Attesting to this methodology, ETOPS demonstrates enormous safety. Despite the commenter's suggestions to the contrary, there are simply no indications that current methods for computing diversion distances are in any way inadequate or need to be reconsidered. It should also be noted that four-engine airplanes are exempt from some of these requirements, although they have at least as great potential for exposure to such events.

The Need for 207-minute ETOPS

Several commenters questioned whether a valid need exists to justify 207-minute ETOPS. For example, commenter (11) argues that the previous 15% extension-from 120 minutes to 138 minutes-met a need for greater safety over the North Atlantic, and was approved to allow diverting twinjets to overfly Greenland's challenging alternate airports in favor of better-equipped and less-demanding alternates.

In fact, 138-minute ETOPS was first introduced in 1985 when ETOPS began under 120-minute diversion authority. Provided for in AC 120-42, this 15% extension beyond the then-maximum of 120 minutes does set a precedent for the industry's current request of another conservative 15% extension some fourteen years later, as explained below.

In 1985, 138-minute ETOPS was neither requested nor approved on the basis of enhanced safety. Instead, pioneering ETOPS operators wanted to be able to fly more directly across the North Atlantic. Operators needed greater flexibility to use all of the North Atlantic's organized tracks even when weather rendered some of the en route alternates unsuitable. When 1 SO-minute ETOPS became available in 1988, the FAA rescinded this 138-minute ETOPS diversion authority. Subsequently, however, it was reinstated in 1995 as explained by FAA ETOPS Policy Letter EPL 95-1, as quoted below:

> It has been determined that a need exists for an additional ETOPS diversion authority between 120 and 180 minutes. The original guidance for extended-range operations with two-engine airplanes in Advisory Circular AC 120-42 dated June 6, 1985, allowed for an Increase up to 15 percent in maximum diversion time (maximum diversion time being 120 minutes) from *suitable* airports. This provision was replaced with the release of the present ETOPS guidance in AC 120-42A dated December 30, 1988, with the Implementation of the 180-minute ETOPS diversion authority. The vast ETOPS experience In the North Atlantic since then has shown that a valid need for a diversion authority similar to the 15 percent increase that had previously been allowed continued to exist. The European Joint Aviation Authority (JAA) in its ETOPS Information Leaflet allows for a 15 percent increase to the 120-minute authority that the operator holds when it can be shown that the resulting route provides an enhancement in overall safety. This provision is almost identical to the 15 percent increase contained In the original AC 120-42.... Some advantages associated with 138-minute ETOPS Include greater flexibility In route (and possible altitude) selection, and an increased number of ETOPS alternates available In the temporarily increased area of operations. There is also relief from fuel requirements associated with 180-minute ETOPS....

Airline operational desires and enhanced safety together justified the *reinstatement* of 138-minute ETOPS in 1995, just the former justified its initial approval a decade earlier. Nevertheless, the identical safety benefits cited in 1995 for 138-minute ETOPS (i.e., greater flexibility in route selection, and more alternate airports available if a diversion becomes necessary) will also result from the approval of 207-minute ETOPS.

One commenter (11) argues that 180-minute ETOPS already existed when 138-minute ETOPS came into being. and that it was a 15% extension to what was then less than the maximum-available diversion authority. Consequently, concludes the commenter, 138-minute ETOPS does not offer a precedent for 207-minute ETOPS, because 207-minute ETOPS would be a 15% extension beyond today's maximum diversion time.

The commenter is able to make this claim only by looking just at ***the reinstatement*** of 138-minute ETOPS in 1995. However, as the above Policy Letter shows, when 138-minute ETOPS first came into being in 1985, the maximum diversion authority was 120-minute ETOPS. Therefore, 138-minute ETOPS does indeed provide a clear precedent for the industry to request and be granted a 15% extension beyond today's maximum diversion authority of 180 minutes. More than a decade of additional experience with ETOPS, during which it has grown enormously and proved hugely successful, underlies and supports the industry's current request for 207-minute diversion authority.

<u>Historical Justification for 207-Minute ETOPS</u>

One commenter (11) states that, "The summary states that 'the 180 minute [ETOPS] limit has been shown to present certain obstacles to reliable operation in the North Pacific'." However, nowhere in the ATA proposal or in this summary section are there any details furnished to justify this statement, or to provide statistical data to support it. We suggest that specific historical data be provided to demonstrate precisely what 'obstacles' have been shown to be present which prevent 'reliable operations' in the North Pacific."

Operators that fly the North Pacific under 180-minute ETOPS rules believe that a 15% extension in ETOPS diversion authority will enhance the *reliability* of their already safe and successful operations. Just as 138-minute ETOPS (a previous 15% extension beyond the then-maximum diversion authority of 120 minutes) eliminated obstacles to enhance the reliability of transatlantic operations in 1985, so too will 207-minute ETOPS eliminate obstacles to enhance the reliability of transpacific operations today. Specific benefits of 207-minute ETOPS to operators will be improved ability to dispatch, greater flexibility in route selection for more-direct and fuel-efficient services, and an increased number of available alternate airports in the event of a diversion.

Use of 207-Minute Diversion Authority

One commenter (11) observes that the stated intent of this proposed rule change is to provide for 207-minute ETOPS operations "on a flight-by-flight exception basis," and notes that it is clearly stated such exceptions would be the infrequent result of weather. However, the fear is expressed that "more frequent, perhaps routine use of this 207-minute authority might occur 'when typically used alternate airports arc temporarily unavailable ***for reasons such as*** weather.. .volcanic eruptions, or other temporary closures'." Citing the possibility that 207-minute ETOPS might be misused to offset the ***extended*** unavailability of designated alternate airports, the commenter calls for a more explicit definition of the precise circumstances under which 207-minute ETOPS can be employed.

As stipulated in the policy letter, all ETOPS operators-including those who are granted 207-minute ETOPS diversion authority-are required to submit to the FAA on a regular monthly basis a record of all the ETOPS flights they have performed. For each flight segment where 207-minute authority was exercised, they must explain the dispatch justification. An industry group, to be determined by the FAA, will review industry data generated by all such operations on a regular basis.

These requirements reflect the safe, conservative, ***evolutionary*** nature of ETOPS, which is a fact-based industry program dependent on the gathering and analysis of operational data. The factual record ***reveals no misuse by airlines of the previous 15% extension*** in diversion authority. Boeing consequently believes that there is no basis for anticipating any abuse of maximum diversion authority today, whether 180 minutes or 207 minutes.

FAA Rulemaking by Ad Hoc Policy

Several respondents question ETOPS rulemaking by advisory circulars and ad hoc policy letters. They believe that normal FAA rulemaking channels would be more appropriate. At the same time, they call for additional ETOPS regulatory harmonization with the JAA. Boeing would support the aviation industry and FAA in a reconsideration of the ETOPS regulatory process.

However, the additional suggestion is made that such a process should be both instituted and completed before the FAA renders its decision on 207-minute ETOPS.

There are numerous areas in operational regulations where the FAA and JAA are not harmonized. Even JAA IL 20 is not harmonized with FAA AC 120-42A; nearly every page in IL 20 is highlighted to show where it differs from the AC. Boeing supports the overall objective of worldwide harmonization of rules, but sees no logical reason for delaying action on the subject proposal.

Commenter Claims That FAA ETOPS Oversight Is Not Satisfactory

One commenter (11) observes that the ATA proposes specific reporting requirements for 207-minute ETOPS, and that the FAA is to gather data and monitor trends. "We are concerned, however," the commenter states, "at the current state of FAA monitoring of ETOPS operations, and do not see these provisions as addressing this need. The regulatory authority should not be in the position of being unable to adequately oversee the regulations it enacts."

It is difficult to understand the basis of this expressed concern. ETOPS is a conservative, fact- and data-driven program that has relied on, and continues to rely on, exhaustive data gathering and analysis. The existing data processes will continue to be used whether ETOPS operators fly under 120-minute, 138-minute, HO-minute, or 207-minute diversion authority. In short, what's served the industry so well since 1985 should continue. Again, it should be pointed out that twins are held to a higher standard of monitoring than their three or four-engine counterparts.

Need for Specific Pass-Fail Criteria

One commenter (11) asserts that, "The numerical probability analysis proposed to be a prerequisite to approval of the airframe-engine combination for 207-minute ETOPS operations does not include any pass-fail criteria. Without such 'pass-fail' criteria, such a requirement is meaningless, and is bound to produce inconsistent results depending upon the analyst."

There is no logic to support the commenters assertions if the same processes and criteria used for 180 minutes are used for 207 minutes also.

Cabin and Flight Deck Temperature in the Event of Air Bleeds

One commenter (I 1) states, "The temperatures and exposure time at diversion altitudes over the North Pacific and other high latitude areas introduce risk factors not covered by current ETOPS risk management criteria. The cockpit and cabin temperatures that will be achieved after only a short time in the event of a double bleed failure (or failure of one engine plus the opposite bleed) are severe enough that such an event should be considered 'catastrophic' in terms of system certification criteria. To ensure compliance with the system certification criteria of FAR 25.1309, it would appear that a third bleed source is necessary over such lengthy diversions at high latitudes in the winter."

Failure conditions and scenarios are evaluated to meet the requirements of FAR 25.1309. These evaluations do indeed address issues and scenarios like those described by the commenter and have been accomplished for Boeing ETOPS twins.

Engine Fan Blade Rupture

One commenter (10) states, "A rupture of an engine fan blade on a very large engine may cause a high level of vibration that transmit to the aircraft structure. The structural consequences of such vibrations depend on the diversion time. The impact of such vibrations on the ability of the crew to perform its duties is also a function of diversion time." Another commenter (I 1) also raises this concern, stating that, "Human factors involving both passengers and crew under conditions of... high vibration levels which might accompany engine windmilling imbalance, etc. have not been adequately addressed."

In fact, fan-blade rupture and the resultant windmilling imbalance have been addressed, as required by FAA Issue Paper A-11. Moreover, the 207-minute ETOPS Policy Letter requires that, "The airframe-engine combination shall be reviewed to determine if there are any factors which would effect safe conduct of 207 minute operations on a flight by flight exception basis as defined in (c) of the 'Discussion' section of this Policy Letter. For information, Section 4, titled "Engine Unbalance Due to Fan Blade Loss," of *B777 Airplane Survivability Assessment Report Addressing FAA Issue Paper A-11 (D01 8W1 01)* assesses the effects of blade-out windmilling vibration on the flight crew. Three profiles were considered during these evaluations, the longest (blade out to landing) having a duration of 4.78 hours.

Essential Functions Including SATCOM on Backup Power

One commenter (10) states that, "In the ATA/ALPA proposal, SATCOM becomes the prime means of long-distance communication. As such, it should become an essential load that remains powered under all normal and emergency configurations."

The Policy Letter requires 'The airframe-engine combination shall be reviewed to determine if there are any factors which would effect safe conduct of 207 minute operations on a flight by flight exception basis as defined in (c) of the 'Discussion' section of this Policy Letter.' Issues like the ones the commenter has raised may be candidates for such a review; however, we suggest all airplanes, regardless of the number of engines, have communications related needs and should be included in my such review.

Comment on ATA/ALPA Engine Oil Proposal

One commenter (10) states that, "The ATA/ALPA proposal concerning the engine oil supply is unnecessary. The engine oil consumption does not significantly increase at Maximum Continuous Thrust (MCT). The oil consumption during a four hours diversion at MCT may in no case exceed the capacity of the engine oil tank that is designed to support the oil consumption for one or more flights of more than 15 hours duration each."

As the oil consumption rates of some engines do increase during extended operation at MCT, Boeing believes that this requirement should remain.

Comment on Cargo Fire Suppression

One commenter (10) states that, 'The ATA/ALPA proposal for the cargo holds fire protection time does not take into account the considerable effect of the wind and below-ISA temperature on the North Pacific routes. The proposed protection time of 222 minutes is insufficient to cover a diversion from the critical point to landing in 85% of the westbound flights. In addition, because a conventional evacuation is impossible at the Arctic airports during the winter, a substantial safety margin must be considered between the landing and the evacuation of the last occupant.

The ETOPS requirement for fire suppression capability 15 minutes beyond maximum diversion authorization (in this case, 222 minutes for 207-minute ETOPS) has served the industry well for 14 years. There is no indication that it might be inadequate. Again, we question the need for even more fire suppression capability when three and four-engine airplanes have no diversion time limit, but very often have a cargo fire protection time of 195 minutes or less.

Numerical Probability Analysis

One commenter states in Section 7.1 of its submittal that, "The requirement to provide a 'Numerical Probability Analysis (NPA)' to support a 207 minute diversion, is not sufficiently explicit." The commenter proposes reassessing ETOPS-significant systems for 207 minutes, and performing "an actual flight test to confirm that continued safe flight and landing is assured, assuming a maximum diversion time, effectively with an engine out and on emergency or standby power."

Definition of systems significant for ETOPS was established during the evaluation of the 777 for 180-minute suitability. The 207-Minute ETOPS Policy Letter states, "Numerical Probability Analysis (NPA) provided to support 180 minutes will be reanalyzed to support a 207-minute diversion." This statement addresses the issue the commenter ha?; raised. Further, regarding a flight test, there are various ways to confirm assurance of continued safe flight and landing, and an actual flight test may not always be the optimum solution.

Backup Power for Failures Not Shown to be Extremely Improbable

One commenter states that, "It would... be more helpful and necessary to require that all essential functions or systems can be supplied with electrical power to ensure continued safe flight and landing following any single failures or combination of failures not shown to be extremely improbable. This in effect requires the provision of a non-time limited emergency power source capable of continuously supplying all essential functions.*' The commenter then offers a list of 15 "services" requiring non-time limited emergency power.

It appears the commenter is advocating the philosophy in JAA IL 20 and proposing the list of systems contained in IL 20. The FAA and JAA are not harmonized in this regard. It should, however, be pointed out that the 777 does preserve essentially full functionality to the flight crew on back-up power.

- The Seattle-Tokyo Great Circle route does not go as far north as the Seattle-Copenhagen route
- One European airline has been operating Seattle-Copenhagen with the 767 since 1990.
- On the Seattle-Tokyo route, all the en route alternates except Anadyr are south of Anchorage.
- Anadyr is at about the same latitude as Iqaluit, a widely used North Atlantic alternate airport.
- The most northerly Seattle-Tokyo flights typically overfly Anadyr.

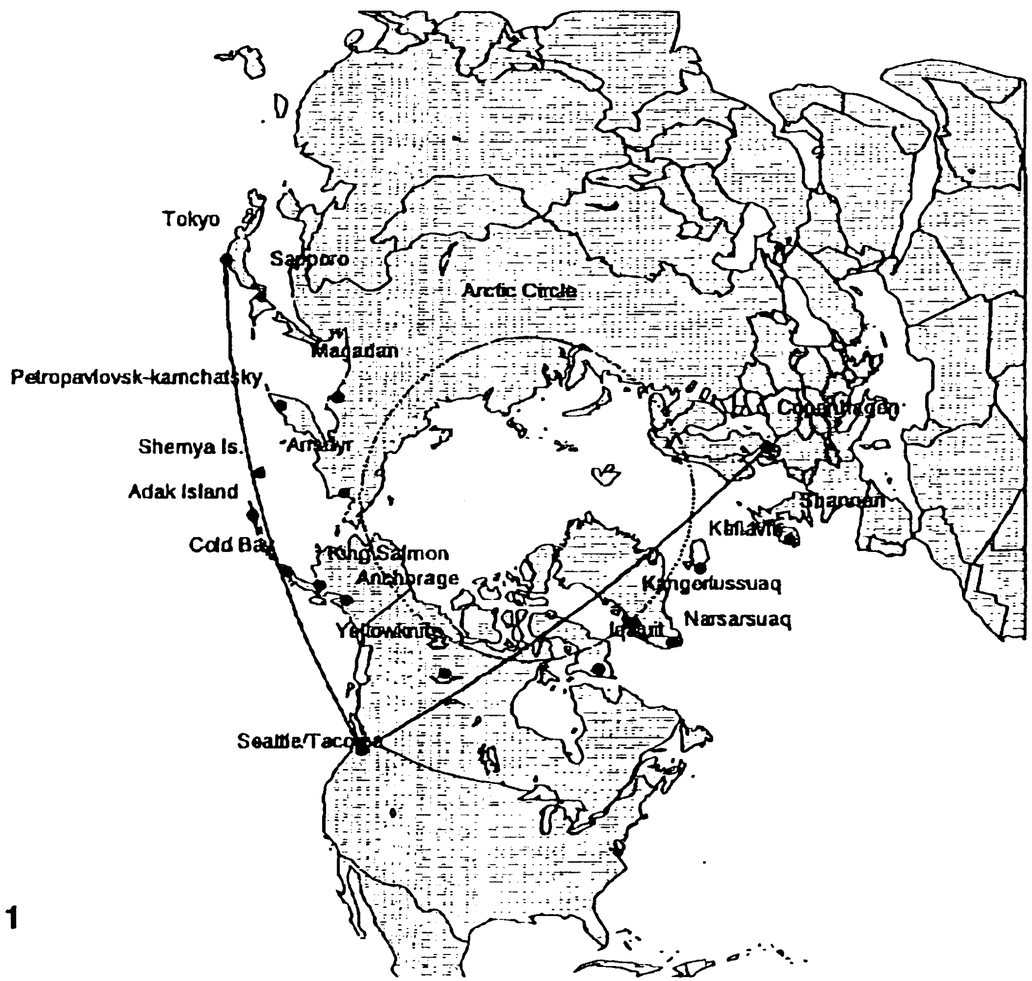

Figure 1

Extract from Type Certification Data Sheet

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

T00001SE
Revision 9
BOEING
777-200Series
777-300Series
June 25, 1998

TYPE CERTIFICATION DATA SHEET T00001 SE

This data sheet, which is part of Type Certificate No, T00001 SE, prescribes conditions and limitations under which the product for which the type certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

Type Certificate Holder: The Boeing Company
PO Box 3707
Seattle, WA 98124-2207

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Model 777-200 Series (Approved April 19, 1995)

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II - Model 777-300 Series (Approved May 4, 1998)

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Note 5. The Model 777-200 and 777-300 airplanes have been evaluated in accordance with FM Special Conditions Number 25-ANM-84, and found suitable for 180-minute Extended Range Operations with Two-Engine Airplanes (ETOPS) operations when operated and maintained in accordance with the following documents. This finding does not constitute approval to conduct ETOPS operations.

Model 777-200
Pratt & Whitney PW4074, PW4077 and PW4077D engines: Appendix I of FM Reliability Assessment Board (RAB) Report Number AT0003SE-T, dated May 25, 1995.

Pratt & Whitney PW4090 engines: Enclosure to FM Letter Number 97-140S-086 dated March 6, 1997.

General Electric GE90-76B engines: Appendix 1 of FAA RAB Report Number TD0303SE-T-2, dated September 30, 1996.

General Electric GE90-85B and GE90-90B engines: Enclosure to FM Letter Number 97-140S-43 dated February 5, 1997.

Rolls-Royce RB211-Trent 884-17 engines: Appendix 1 of RAB Report Number TD0302SE-T, dated October 4, 1996.

Rolls-Royce RB211-Trent 892-17 engines: Enclosure to FAA Letter Number 97-140S-127, dated April 10, 1997.

Model **777-300**
Pratt & Whitney PW 4090 engines: Enclosure to FM Letter Number 98-140S-086, dated March 6, 1997.

Rolls-Royce RB211-Trent 892-17 engines: Enclosure to FAA Letter Number 97-140S-127. dated April 10, 1997.

Applicable to General Electric GE-90 and Rolls-Royce RB211-Trent 800 series engines only:
In order to comply with paragraph (f) of Special Conditions Number 25-ANM-84, Boeing must report the failure events listed in Appendix 2 of RAB Report Number AT0003SE-T within 24 hours after determining that the problem has occurred.

Applicable to Rolls-Royce RB211-Trent 800 series engines only: The Rolls-Royce Trent 800 series engine models approved for ETOPS arc the same as those listed in this data sheet for the basic airplane model. The engine model number is identified on the engine data plate under the column labeled HARDWARE CONFIG. The applicable configuration, maintenance, and procedures (CMP) requirements identified in this note arc based on the engine build standard identified by the highest thrust rating listed in the column labeled TEST CERTIFIED on the engine data plate. There are two basic engine build standards certified on the Model 777-200 and -300 airplanes: RB211-Trent 884-17 and RB211-Trent 892-17.

Copies of the documents referenced in this note may be obtained upon request from the Manager, Seattle Aircraft Certification Office, 1601 Lind Avenue SW, Renton, WA 98055.

Extract from Type Certificate Data Sheet

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

A1NM
Revision **15**
BOEING
767-200 Series
767-300 Series
767-300F Series
August 1, 1997

TYPE **CERTIFICATE DATA SHEET A1NM**

This data sheet, which is part of Type Certificate No. A1NM, prescribes conditions and limitations under which the product for which the type certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

Type Certificate Holder: The Boeing Company
PO Box 3707
Seattle, WA 98124

I - Model 767-200 (Approved July 30, 1982)

....

II - Model 767-300 (Approved September 22, 1986)

III - Model 767-300F (Freighter) (Approved October 12, 1995)

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DATA PERTINENT TO ALL MODELS

Note 7. The type design reliability and performance of this airplane has been evaluated in accordance with FAA Advisory Circular 120-42A and found suitable for extended range operations when configured in accordance with Boeing Document D6T11604 "CONFIGURATION, MAINTENANCE AND PROCEDURES FOR EXTENDED RANGE (ER) OPERATION". This finding does not constitute approval to conduct extended range operations.

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BOEING

1 .0 Introduction

This document presents the Model 767 airplane configuration, maintenance and procedure standards for extended range operations (ETOPS) up to 180 minutes diversion time from an alternate airport. Upon incorporation of these standards, type design of the Model 767 is found to be suitable for ETOPS operation in accordance with the provisions of FAA Advisory Circular (AC) 120-42 or AC 120-42A, as applicable. A summary of the specific airplane/engine combinations approved for ETOPS are provided in Section 1.1 together with the type design approved diversion time.

The standard identified in this document, by reference documentation and revision level, establishes a minimum standard for ETOPS. Subsequent FAA approved revisions to the reference documentation (same Service Bulletin or Letter with follow-on revision number), or FAA approved superseding documentation (service bulletin, or letter, with later date which addresses the same modification) may be used, but are not required. This may include subsequent FAA approved parts (follow-on part dash numbers or follow-on replacements for parts defined in service bulletins and letters called out in this document).

This document cannot be the sole source of information relative to ETOPS configuration. maintenance or operational procedures. Operators can develop alternate configuration items, incorporation schedules, and/or procedures for any entry in this document. These modifications would require regulatory authority approval that would be obtained via the customary approval processes for such changes. These operator generated. regulatory agency approved, alternatives will not normally be included in this document.

Normally the configuration, maintenance, and operating items identified in this document should be implemented prior to the initiation of ETOPS operations. Items identified by an asterisk (*) should be accomplished per the accomplishment date in this document. In the absence of a date, or number of cycles, or hours, the manufacturer's recommended schedule should be followed. Where specific accomplishment date is given, e.g., "Incorporate at next shop visit, no later than December 1993", the required time is relative to the approval date of this document. The local regulatory agency should allow the operator a reasonable period of time after approval of this document to begin incorporation of these items.

Specific lists and information provided in the document include:

a. A list of ETOPS airplane operational capability items and associated reference documentation identified by Boeing or Supplier Service Bulletins and approved equivalents.

b. A list of Maintenance Manual or Service Letter items which are non-optional for ETOPS

c. A list of Operations Manual Bulletins which are non-optional for ETOPS

SEVERE TURBULENT AIR PENETRATION

Flight through severe turbulence should be avoided, if possible.

The recommended procedures for inadvertent flight in severe turbulence are:

1. Airspeed

   Approximately 270 knots below 25,000 feet, or 280 knots/0.84 Mach, whichever is lower, at 25,000 feet and above. Severe turbulence will cause large and often rapid variations in indicated airspeed. DO NOT CHASE THE AIRSPEED.

2. Autothrottle - OPTIONAL

   Monitor autothrottle performance and disconnect if unacceptable.

3. Autopilot - OPTIONAL

   Monitor autopilot performance and disconnect if unacceptable.

4. Attitude (When flying manually)

   Maintain wings level and the desired pitch attitude. Use the attitude indicator as the primary instrument. In extreme drafts, large attitude changes may occur. DO NOT USE SUDDEN LARGE CONTROL INPUTS. After establishing the trim setting for penetration speed, DO NOT CHASE PITCH TRIM.

5. Altitude (When flying manually)

   Allow altitude to vary. Large altitude variations are possible in severe turbulence. Sacrifice altitude in order to maintain the desired attitude and airspeed. DO NOT CHASE ALTITUDE.

EXTENDED RANGE OPERATIONS

The type design reliability and performance of this airplane/engine combination has been evaluated in accordance with 25-ANM-84 FAA Special Condition: "EXTENDED RANGE OPERATIONS OF BOEING MODEL 777 SERIES AIRPLANE", dated July 1, 1994, and found suitable for extended range operations. This finding does not constitute approval to conduct extended range operations.

BOEING 767

AIRPLANE FLIGHT MANUAL

NORMAL PROCEDURES

OPERATION IN ICING CONDITIONS

Engine ignition is on (AUTO position).

The **primary** method of operating the wing anti-ice **system** is to **operate it as** a de-icing system. Ice accumulation on the cockpit front window frames, windshield center post, windshield wiper **post,** or side windows can be used as an indication of airframe icing conditions and the need to **turn on** the wing anti-ice system.

If a primary ice detection and activation system is installed **and** operative, the wing anti-ice selector **may** be selected to the AUTO position continuously *in* flight in lieu of **the above** normal procedure.

EXTENDED RANGE OPERATIONS

The type design reliability and performance of **this airplane/engine** combination has been evaluated in accordance with FAA Advisory Circular **120-42A** and found suitable for extended range operations when configured in accordance with Boeing Document **D6T11604** "CONFIGURATION, MAINTENANCE AND PROCEDURES FOR EXTENDED **RANGE (ER)** OPERATION". This finding does not constitute approval to conduct extended range operations.

AUXILIARY POWER UNIT

APU starts **may** be attempted **at** any altitude. **APU** may not start above **35,000** feet.

METRIC ALTITUDE INDICATOR (if installed)

Metric **altitude** indicators are for reference use only and **shall** not be used **as** the primary means of altitude indication for flight **operations.**

NORMAL PROCEDURES

OPERATION IN ICING CONDITIONS

Engine ignition is on (AUTO position).

The primary **method** of operating the wing **anti-ice system is to** operate **it as a** de-icing system. **Ice accumulation on** the cockpit front window frames, windshield center **post,** windshield wiper post, **or side windows can** be **used** as an Indication **of airframe** icing conditions and the need to turn on the wing anti-ice system.

EXTENDED RANGE OPERATIONS

The type design **reliability and performance of** this **airplane/engine** combination has been evaluated in accordance **with FAA Advisory Circular 120-42** and found suitable **for extended** range **operations when** configured 'in accordance **with Boeing Document D6T11604** "CONFIGURATION, **MAINTENANCE** AND PROCEDURES FOR EXTENDED **RANGE (ER)** OPERATION" . This finding does not **constitute approval to conduct** extended **range** operations.

Shemya weather is available!!!

Sample: Weather at 2032Z Thursday 17 June

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SYA 2259 162255Z 08020KT 1/4SM FG VV001 06/06 A2979 RMK SLP085
    WR// T00560056
SYA 0002 162355Z 08019024KT 1/2SM -RA FG VV001 06/06 A2978 RMK
    SLP082 60001 70024 50000 WR// P0000 T00560056 10067 20056
SYA 0034 170020Z 07020KT 1SM -RA BR VV001 06/06 A2977 RMK SLPNO
SYA 0100 170055Z 07018KT 1/2SM -RA FG VV001 06/06/ A2977 RMK
    SLP076 WR//
SYA SP 0129 170115Z 06018KT 2SM -RA BR SCT000 OVC001 06/06
    A2976 RMK BR SCT000
SYA 0153 170138Z COR 07017KT 1SM -RA BR VV001 06/06 A2976
SYA 0157 170155Z 07016KT 1/2SM -RA FG VV001 06/06 A2976 RMK
    SLP074 WR// LAST
SYA 1742 171730Z 05016KT 1/4SM FG VV001 06/06 A2976 RMK SLPNO
    WR// FIRST
SYA 1800 171755Z 05015KT 1/8SM FG VV001 04/04 A2976 RMK SLP075
    6//// 5//// WR// P0000 T00390039 10056 20039
SYA 1818 171813Z 05015KT 1/4SM FG VV001 04/04 A2977 RMK SL
    SLPNO
SYA 1853 171814Z COR 05015KT 1/4SM FG VV001 04/04 A2977 RMK
    SLPNO COR 1842 T00390039
SYA 2004 171955Z 04017KT 1/4SM FG VV001 04/04 A2977 RMK SLP077
    WR// T00390039
SYA TAF17 1710 AMD 171713 05017KT 0400 FG VV001 QNH2971INS WND
    03014KT AFT 00
    TEMPO 2002 1600 BR OVC002 T05/01Z T03/15Z AMD 1703

;06172032 108557 0893
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