**Twenty Ninth Meeting of the
Informal South Pacific ATS Co-ordinating Group
(ISPACG/29)**

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Agenda Item RNP-4 Equipage

LOST FUEL SAVINGS DUE TO LACK OF RNP 4 & FANS-1A EQUIPAGE

Presented by Federal Aviation Administration

SUMMARY

This paper identifies denied aircraft requests for climb to optimum altitudes and places a value on the increased fuel burn due to lack of Future Air Navigation System (FANS) equipment and RNP 4 certification.

1. INTRODUCTION

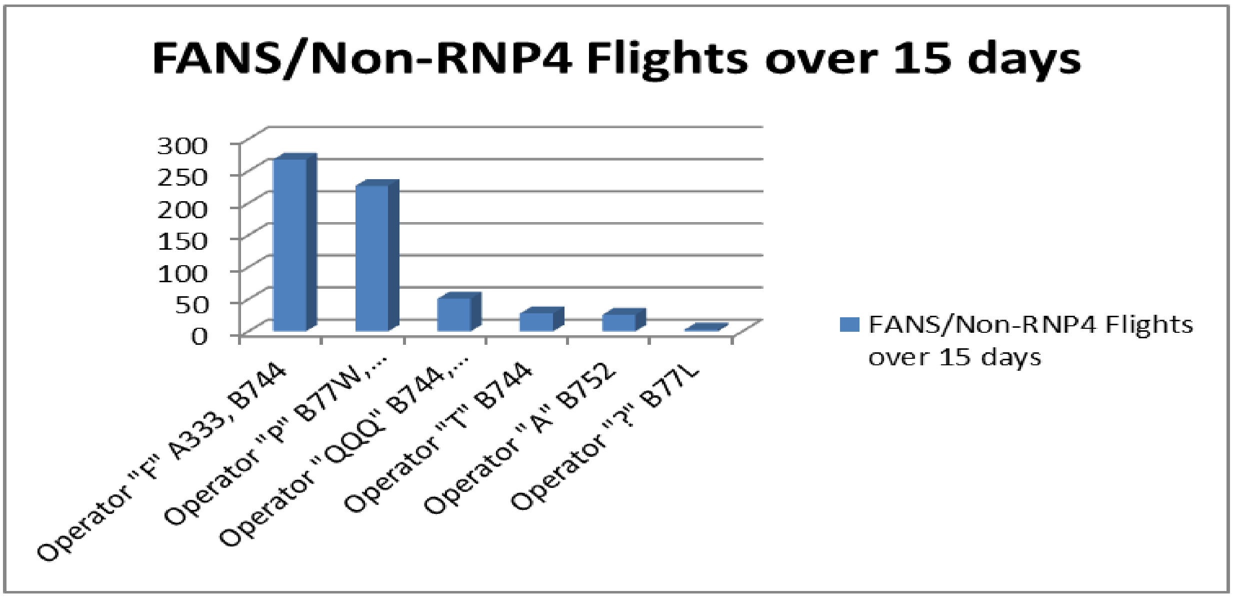
1.1 When aircraft are FANS equipped and RNP 4 certified, Oakland Oceanic controllers can apply Automatic Dependent Surveillance-Contract (ADS-C) separation rules between pairs of properly equipped aircraft. Smaller separation standards allow aircraft to operate at more efficient routes and altitudes. This paper focuses on extra fuel burn due to denied altitude change requests because of lack of aircraft FANS and RNP 4 equipage.

2. DISCUSSION

2.1 FANS equipped aircraft are able to qualify for RNP 4 certification. Since the fuel burn savings metrics in this paper were first developed, there has been a significant closure in the gap between the percentages of RNP 4 and FANS-1A equipped aircraft in the Oakland Oceanic Control Area (CTA). In May 2012, 51 percent of aircraft in the Oakland CTA were FANS-1A equipped, but only 30 percent of aircraft flight planned RNP 4 equipage. That was a gap of 21 percent of aircraft capable of being certified as RNP 4 but were not flight planning the equipage. Currently, about 63 percent of flights in the Oakland Oceanic FIR are FANS equipped and 58 percent flight plan RNP 4. There is still a gap of about 5 percent of flights that are capable of RNP 4 but that do not flight plan with RNP 4 equipage. Over the last 2 years, the gap has closed 13 percent between RNP 4 and FANS-1A equipped aircraft. Additionally, the percentage of FANS-1A equipped aircraft has increased by 12 percent over the same time period.

2.2 Some operators do not flight plan RNP 4 because of the extra cost associated with more frequent ADS-C reports. A FANS, RNP 4 flight planned aircraft in the Oakland Oceanic FIR receives an ADS-C reporting rate of 832 seconds (13 minutes 52 seconds). A FANS, RNP 10 aircraft receives an ADS-C reporting rate of 1600 seconds (26 minutes 40 seconds). So it is true that a FANS, RNP 4 aircraft will have more ADS-C reports operating on the same routes in the Oakland FIR. However, when you examine the overall costs, it is more efficient to flight plan with RNP 4 equipage. Over an 8 hour flight, an RNP 4 aircraft will send 35 ADS-C periodic reports. Over the same 8 hour flight, an RNP 10 aircraft will send 18 ADS-C periodic reports. The difference is 17 extra ADS-C reports for an RNP 4 aircraft. Assuming an average cost for an ADS-C periodic position report of 0.25 US dollars ($0.25), the extra cost in ADS-C reports adds up to $4.25. Consider that a gallon of fuel weighs 6.65 pounds (lbs) and costs a conservative $3.25 a gallon. A B744, held 1000 feet below its optimum altitude, burns approximately 288 pounds per hour of fuel more than at their optimum altitude. That means that the B744 will burn up that $4.25 in fuel in only 1.81 minutes by operating only 1000 feet below its optimum altitude. RNP 4 and FANS will greatly increase the likelihood that the aircraft will be able to operate at its optimum altitude.

2.3 In July 2014 there were 6 operators in the Oakland FIR who used FANS-1A equipment but failed to flight plan RNP4. Two of the operators account for 82 percent of the FANS-1A/Non-RNP4 aircraft in the Oakland FIR. The chart below lists the number of flights over 15 days for the de-identified operators. The Operator codes are the same codes that are used to identify FANS performance. States need to work with their operators to help them certify their aircraft as RNP 4 capable. RNP 4, FANS equipped aircraft operate at more fuel efficient altitudes and reduce carbon dioxide (CO_2) emissions. Reductions in CO_2 emissions lessen the impact of global aviation on the environment.



2.4 Oakland Air Route Traffic Control Center (ARTCC) conducted a study to place a value on the extra fuel burn that is caused by aircraft operating at altitudes below their optimum altitude due to lack of RNP 4 and FANS equipment. The FAA felt this analysis would help operators recognize the potential savings with RNP 4 and FANS equipage. The following are the details on how the extra fuel burn is calculated:

2.4.1 To calculate the extra fuel burn, the FAA worked with the operators and International Air Transport Association (IATA) to develop a table of how much extra fuel each aircraft type burns when it is in thousand feet increments below the aircraft's optimum altitude. This table is provided as an attachment to this paper.

2.4.2 To determine when an aircraft is below its optimum altitude, the program tracks when an aircraft makes a request for a climb clearance and the climb is denied by air traffic control (ATC). The requested altitude is tracked as the aircraft's optimum altitude. The program examines the blocking traffic and looks to see if the conflict is same direction traffic and the distance to the traffic is 16 nautical miles (NM) or more (ADS-C Climb Descend

Procedure[CDP]). If these conditions are met, the program will track the time the aircraft is below their optimum altitude.

2.4.3 The time the aircraft is below its optimum altitude is multiplied by the data in the extra fuel burn table. This allows us to calculate the extra fuel burned because an aircraft is operating below optimum altitude. The program also tracks interim step climbs and updates in requested altitude and figures this data in the calculation.

2.4.4 Over the past 25 months, five 15 day time periods were examined. The results from the first 3 data collections were very similar. 1-16 April 2012 showed a lost savings of 27,331 kilograms (kg) for the 15 days. 10-24 September 2012 showed a lost savings of 28,829 kg for those 15 days. 6-21 January 2013 showed a lost savings of 28,858 kg for those 15 days.

2.4.5 For the calculations in the fourth analysis, 15 days of data (September1-16, 2013) were examined in the Oakland Oceanic FIR. The results show that an extra fuel burn of 21,310 kilograms (kg) (46,882 lbs) was experienced due to lack of RNP 4 and FANS equipment. If the data are extrapolated over a 1 year time period, an annual extra burn of 518,543 kg (1,140,795 lbs) of fuel and an extra 1.6 million kg of CO_2 emissions would be realized.

2.4.6 The September 2013 extra fuel burn analysis indicated a smaller potential fuel burn savings, but the savings were still significant. One possible reason for the smaller fuel burn savings found during this data collection may be explained by the increase in RNP 4 aircraft since April 2012 when the first extra fuel burn due to the lack of RNP 4 data analysis occurred. In March 2012, in the Oakland Oceanic FIR, the percentage of RNP 4 aircraft was at 32 percent. The percentage of RNP 4 aircraft has now risen to 60 percent. With more RNP 4, FANS 1A equipped aircraft can realize more frequently, altitude assignments that are closer to their optimum operating altitude.

2.4.7 As part of this ongoing analysis we have reported in the past that there is an extra fuel burn associated with RNP 4/FANS1A aircraft that were denied altitude changes because the conflicting traffic was not RNP 4 equipped. For the 2014 analysis we were able to calculate a fuel burn loss for these RNP 4 aircraft. From July 23-August 7, 2014, RNP 4 aircraft experienced an extra fuel burn of 18,267 kg (40,187 lbs) due to other non-RNP 4 aircraft. That means the total extra fuel burn due to lack of RNP 4 and FANS1A equipment was 37,001kg (81,402 lbs). If the data is extrapolated over a 1 year time period, an annual extra burn of 900,366 kg (1,980,805 lbs) of fuel and an extra 2.84 million kg of CO_2 emissions would be realized.

2.5 While this data is based on every aircraft being RNP 4 and FANS equipped, it does not capture all of the benefits that can be realized by this equipage:

2.5.1 This paper does not capture the benefits related to the application of 30 NM lateral separation for pairs of RNP 4 aircraft. It would be much more difficult to make this calculation.

2.5.2 This paper does not capture the benefits associated with the application of 30 NM longitudinal separation for opposite direction pairs of RNP 4 aircraft after the aircraft have passed. It would be much more difficult to make this calculation.

2.5.3 This paper does not capture the benefits that are lost when an aircraft is denied a request for climb due to traffic, and the aircraft does not make subsequent requests for higher optimum altitudes because of the traffic.

2.5.4 ATS Route Structures and Pacific Organized Track System (PACOTS) are developed based on a 50 NM lateral separation standard. Extra savings could be realized if route structures could be revised based on a 30 NM lateral separation standard.

2.5.5Most of all, this paper only captures the lost savings in the Oakland FIR. It does not capture the lost savings in other FIRs.

2.6 One last thing to consider when analyzing the benefits of RNP 4 and FANS1A equipment is traffic growth in the Pacific. In July2009, traffic levels in the Oakland FIR hit a low of 500 flights per day on average. Five years later in 2014, traffic levels have rebounded to levels above the downturn in traffic in 2008. In December of 2014, the Oakland Oceanic FIR experienced an average of around 715 flights per day. That is a traffic increase of almost 43 percent since July 2009. With more aircraft in the Pacific airspace, there is more competition for optimum altitude assignments. The data clearly shows that RNP4 and FANS1A equipped aircraft have a higher likelihood of operating at their optimum altitude.

3. ACTION BY THE MEETING

3.1 Significant fuel burn savings can be realized by aircraft with RNP 4 and FAN-1A equipment. Operators should recognize the benefits of RNP 4 and FANS equipment. They should:

3.1.1 Consider certifying FANS equipped aircraft as RNP 4; and

3.1.2 Consider equipping aircraft with satellite FANS and RNP 4 certification.

ATTACHMENT 1

Aircraft Type A320, Flight length 2500NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	36
2000 ft below optimum altitude	72
3000 ft below optimum altitude	118
4000 ft below optimum altitude	172
5000 ft below optimum altitude	254
6000 ft below optimum altitude	336

No data used B757 data

Aircraft Type A332, Flight length 4454NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	35
2000 ft below optimum altitude	71
3000 ft below optimum altitude	136
4000 ft below optimum altitude	182
5000 ft below optimum altitude	251
6000 ft below optimum altitude	321

Extrapolated Data

Aircraft Type B737, Flight length 2100NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	13
2000 ft below optimum altitude	24
3000 ft below optimum altitude	53
4000 ft below optimum altitude	89
5000 ft below optimum altitude	142
6000 ft below optimum altitude	272

Aircraft Type B738, Flight length 2100NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	13
2000 ft below optimum altitude	24
3000 ft below optimum altitude	53
4000 ft below optimum altitude	89
5000 ft below optimum altitude	142
6000 ft below optimum altitude	272

Aircraft Type B744, Flight length 5500NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	131
2000 ft below optimum altitude	133
3000 ft below optimum altitude	348
4000 ft below optimum altitude	397
5000 ft below optimum altitude	761
6000 ft below optimum altitude	800

Aircraft Type B752, Flight length 2100NM, Average weight	
Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	48
2000 ft below optimum altitude	81
3000 ft below optimum altitude	119
4000 ft below optimum altitude	150

5000 ft below optimum altitude	214
6000 ft below optimum altitude	254

Aircraft Type B763/B764, Flight length 2100NM, Average weight

Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	52
2000 ft below optimum altitude	84
3000 ft below optimum altitude	117
4000 ft below optimum altitude	164
5000 ft below optimum altitude	238
6000 ft below optimum altitude	327

Aircraft Type B772, Flight length 5500NM, Average weight

Altitude	Ave Additional Fuel burn per hour kg
1000 ft below optimum altitude	20
2000 ft below optimum altitude	139
3000 ft below optimum altitude	292
4000 ft below optimum altitude	312
5000 ft below optimum altitude	595
6000 ft below optimum altitude	640