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Agenda Item 3: Reports from Asia/Pacific RMAs and EMAs

HORIZONTAL SAFETY MONITORING REPORT FROM THE PACIFIC APPROVALS REGISTRY AND MONITORING ORGANIZATION DECEMBER 2010 – NOVEMBER 2011

(Presented by (Presented by The United States/Pacific Approvals Registry and Monitoring Organization (PARMO))

SUMMARY

This working paper presents the horizontal safety monitoring report from the Pacific Approvals Registry and Monitoring Organization (PARMO) for the time period 1 December 2010 to 30 November 2011. This report contains a summary of large longitudinal errors and large lateral deviations received by the PARMO for that time period and the related performance monitoring activities for the Anchorage and Oakland Flight Information Regions.

This paper relates to –

Strategic Objectives:

*A: **Safety** – Enhance global civil aviation safety*

Global Plan Initiatives:

GPI-16 Decision support systems and alerting systems
GPI-21 Navigation systems
GPI-22 Communication infrastructure

1. INTRODUCTION

1.1 The Pacific Approvals Registry and Monitoring Organization (PARMO), a service provided by the U.S. Federal Aviation Administration's Technical Center, serves as the En-route Monitoring Agency (EMA) for the Anchorage and Oakland Oceanic Flight Information Regions (FIRs). The report presented in this paper fulfils the ICAO emphasis on safety management systems; such reporting for international airspace is a component of safety management systems.

1.2 This report covers the current reporting period 1 December 2010 to 30 November 2011 in the PARMO's ongoing process of providing periodic updates of information relevant to the continued safe use of the reduced lateral and longitudinal separation standards in the Anchorage and Oakland FIRs. This report follows the standardized reporting period and format guidelines set forth by the ICAO's Asia and Pacific Region Regional Airspace Safety Monitoring Advisory Group (RASMAG). These guidelines are stated in reference 1, paragraph 5.34.

1.3 Within this report, the reader will find the large lateral deviation and large longitudinal error reports received by the PARMO during the reporting period and a discussion of the monitoring activities conducted by the PARMO. There were a total of 5 such reports submitted to the PARMO during the reporting period.

2. DISCUSSION

2.1 Horizontal Separation Standards Applied In the Anchorage and Oakland Firs

2.2 *Lateral Separation Standards*

2.2.1. The lateral separation standard applied in the Anchorage and Oakland FIR can vary. The 50NM lateral separation standard can be applied to RNP10 aircraft, however, if the airspace is not exclusionary. Non-RNP10 aircraft are permitted to operate within the airspace. Anchorage and Oakland oceanic ATC apply another form of aircraft separation (either longitudinal or vertical) for non-RNP10 aircraft.

2.2.2. In the Oakland FIR, the 30NM lateral separation standard can be applied to suitably equipped RNP4 operations. The application of the 30NM lateral separation in the Oakland FIR is accomplished ad hoc between pairs of suitably equipped aircraft; this means that the application of the separation minima is not planned prior to oceanic entry. In the near future, the FAA intends to implement the 30NM lateral separation standard in the same manner within the Anchorage FIR.

2.3 *Longitudinal Separation Standards*

2.3.1. The longitudinal separation standard applied in the Anchorage and Oakland FIR can vary. The 10-minute longitudinal separation can be applied with or without mandatory assignment of Mach number. The 50NM longitudinal separation standard can be applied to RNP10 aircraft using ADS-C for position reporting and Controller Pilot Data Link Communication (CPDLC) to communicate with ATC. A 27 minute interval for ADS-C periodic reports is assigned to aircraft eligible for the 50NM longitudinal separation. The application of the 50NM longitudinal separation in the Anchorage and Oakland FIRs is accomplished ad hoc between pairs of suitably equipped aircraft; this means that the application of the separation minima is not planned prior to oceanic entry.

2.3.2. In the Oakland FIR, the 30NM longitudinal separation standard can be applied to suitably equipped RNP4 operations. A 14 minute interval for ADS-C periodic reporting is assigned to aircraft eligible for the 30NM longitudinal separation standard. The application of the 30NM longitudinal separation in the Oakland FIR is also done ad hoc between pairs of suitably equipped aircraft. In the near future, the FAA intends to implement the 30NM longitudinal separation standard in the same manner within the Anchorage FIR.

2.4 *Data Sources*

2.4.1. Monthly large lateral deviation (LLDs) and large longitudinal errors (LLEs) are forwarded to the PARMO from the Anchorage and Oakland oceanic FIRs. The ATC facilities have the surveillance information available in the form of voice or automatic dependent surveillance (ADS-C) reports and, where available, secondary surveillance radar Mode C returns. These data are used to support the estimation of risk for the airspace.

2.4.2. The FAA's Air Traffic Quality Assurance (ATQA) database provides access to several principal aviation safety data and information sources. The PARMO scans this database periodically in search of incidents occurring in Pacific airspace. These data are supplement the large height deviation reports received from the ATS providers.

2.4.3. Additional reports of large height deviations are occasionally received from various operators. The PARMO reviews these reports and includes them, as appropriate, with the reports received from the ATS providers in estimating the overall risk for the airspace.

2.4.4. Traffic movement data are collected through the FAA's Enhanced Traffic Management System (ETMS) and the archived data from the FAA ATC automation system. These data encompass traffic movements from the Anchorage and Oakland FIRs. Each traffic movement record within the ETMS data sample contains the date, time, latitude, longitude, flight level, aircraft flight identification, aircraft type, origin/destination airports and a field indicating the type of record.

2.4.5. Data link transmission data obtained from operations conducted within the Anchorage and Oakland oceanic FIRs are obtained daily at the FAA Technical Center. In the future, these data collections will be part of the data archiving process through the FAA ATC automation system. These data include the required time stamps from data link messages to measure performance as described in the ICAO GOLD (reference 3). Specific pilot-controller CPDLC message sets are used to estimate the actual communication performance (ACP), actual communication technical performance (ACTP), and pilot operational response time (PORT). In addition, ADS-C surveillance performance is measured. Appendix D to the GOLD (reference 3) provides the post implementation modeling and corrective action details for use of ADS-C and CPDLC data link in airspace.

3. DATA SUBMISSION

3.1 The most recent annual one-month traffic movement samples for December 2009 were received from both the Oakland and Anchorage FIRs. These traffic movement samples are used to update the horizontal risk estimates and related monitoring activities described in this report.

3.2 Monthly reports of LLDs and LLEs were also received from both the Anchorage and Oakland FIRs for the time period December 2010 through November 2011. Additional event data were available through the FAA ATQA database.

4. LARGE LATERAL DEVIATION AND LARGE LONGITUDINAL ERROR REPORT SUMMARY

4.1 Table 1 contains a summary of the number of risk-bearing LLD and LLE occurrences during the time period 1 December 2010 to 30 November 2011 in the Anchorage and Oakland oceanic FIRs.

Table 1. Summary of LLD and LLE Occurrences in Anchorage and Oakland Oceanic Airspace

Month-Year	Number of LLD and LLE Occurrences
Dec-10	0
Jan-11	0
Feb-11	1
Mar-11	1
Apr-11	0
May-11	2
Jun-11	0
Jul-11	0
Aug-11	0
Sep-11	1
Oct-11	0
Nov-11	0
Total	5

4.2 The LLD and LLE reports are separated by categories based on the details provided for each event. These categories are defined in the ICAO Asia Pacific Region EMA Handbook (reference 2). Table 2 lists the categories for LLDs and LLEs for use in the Asia Pacific region.

Table 2. Deviation Codes and Category Description for LLD and LLE Occurrences for the Asia Pacific Region

Deviation Code	Cause of Deviation
Operational Errors	
A	Flight crew deviate without ATC Clearance;
B	Flight crew incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.);
C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position;
D	ATC system loop error (e.g. ATC issues incorrect clearance, Flight crew misunderstands clearance message etc);
E	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility;
Deviation due to navigational errors	
F	Navigation errors, including equipment failure of which notification was not received by ATC or notified too late for action;
Deviation due to Meteorological Conditions	
G	Turbulence or other weather related causes (other than approved);
Others	
H	An aircraft without PBN approval;
I	Other

4.3 A summary of the LLD and LLE reports received by the PARMO is contained in Table 3. Four of the reports listed in Table 3 are all LLD events. Three of these events were caused by the flight crew following portions of the filed flight plan rather than the ATC cleared flight plan.

4.4 The event listed in Table 3 with an assigned deviation code 'D' is a LLE report. In this case, an ATC system loop error caused a hear-back read-back error in issuing a climb clearance to an aircraft.

4.5 The last report listed in Table 3 with an assigned deviation code 'A' is a LLD report. In this case, the air crew did deviated without ATC clearance from their expect route.

Table 3. Summary of LLD and LLE Reports Received by the PARMO

Deviation Code	Cause of Deviation	Number of Occurrences
A	Flight crew deviate without ATC Clearance;	1
B	Flight crew incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.)	3

D	ATC system loop error (e.g. ATC issues incorrect clearance, Flight crew misunderstands clearance message etc);	1

5. OBSERVED APPLICATION OF THE REDUCED HORIZONTAL SEPARATION STANDARDS

5.1 The application of the reduced longitudinal separation minima (30NM and 50NM) within the Anchorage and Oakland oceanic FIRs are examined through archived ADS-C position reports. The proportions of aircraft operations with the distance-based longitudinal separation applied are presented in Figures 1 - 3.

5.2 Figure 1 contains the proportion of aircraft operations within the North Pacific (NOPAC) traffic flow observed with the 50NM distance-based longitudinal separation applied. These data are presented by month for the time period September 2010 – August 2011. Figure 1 also shows the total proportion of operations using ADS-C for position reporting within the Anchorage oceanic FIR. The ADS-C data are presented because ADS-C periodic reporting is one of the requirements aircraft operations need to be eligible for the 50NM longitudinal separation standard.

5.3 Figure 2 contains the observed proportions of aircraft operations within the Oakland oceanic FIR with the 50NM distance-based longitudinal separation applied. Figure 3 contains the observed proportions of aircraft operations within the Oakland oceanic FIR with the 30NM distance-based longitudinal separation standard applied, all of these aircraft operations were observed within the Central Pacific (CENPAC) traffic flow. These data are presented by month for the time period September 2010 – August 2011. The proportions of operations utilizing ADS-C periodic reporting are also presented in Figures 2 and 3. Aircraft operations eligible for the 30NM and 50NM longitudinal separation standards must utilize ADS-C for position reporting.

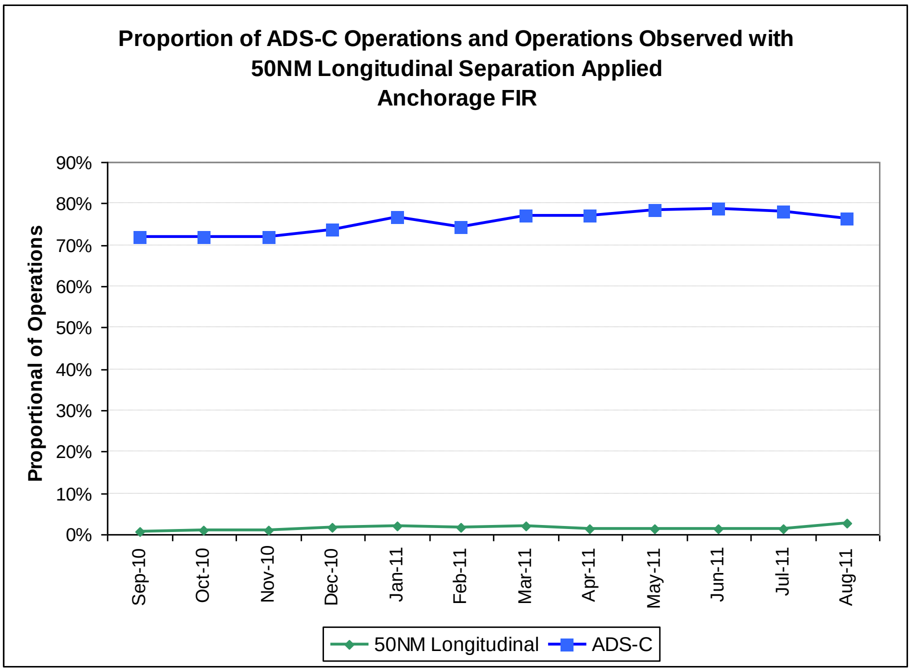

Figure 1. Proportion of Aircraft Operations Observed with the 50NM Longitudinal Separation Applied in the Anchorage Oceanic FIR by Month

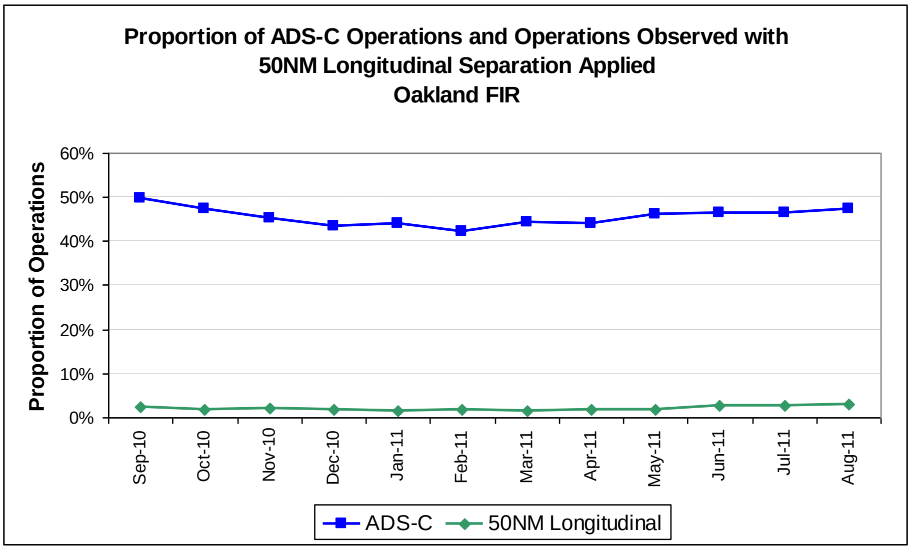

Figure 2. Proportions of Aircraft Operations Observed with the 50NM Longitudinal Separation Applied in the Oakland Oceanic FIR

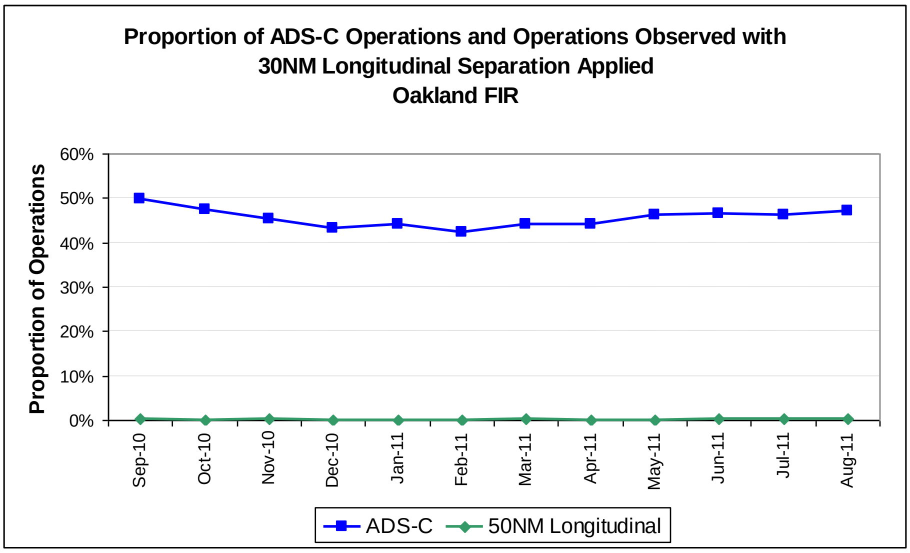

Figure 3. Proportion of Aircraft Operations Observed with the 30nm Longitudinal Separation Applied in the Oakland Oceanic FIR

5.4 Figures 1 – 3 show relatively small proportions of operations were observed with the reduced separation standards applied. This result is partially due to the application of the reduced separation standards ad hoc between pairs of suitably equipped aircraft. Other contributing factors are the proportions of ADS-C operations and the proportion of RNP4 and RNP10 operations. The data in Figures 1 – 3 show that there are operations conducted within both Anchorage and Oakland airspace which are not utilizing ADS-C and therefore not eligible for the reduced longitudinal separation standards. The observed proportions of RNP4 and RNP10 operations are not shown in Figures 1 – 3.

6. OBSERVED DATA LINK PERFORMANCE

6.1 The PARMO examines the aircraft ADS-C periodic reports in the archived data and identifies cases of overdue reports. Special analyses are completed involving overdue reports from the RNP4 approved aircraft which assigned 14-minute reporting rates. Figures 4 and 5 contain the proportion of missing ADS-C reports in Anchorage and Oakland airspace, respectively.

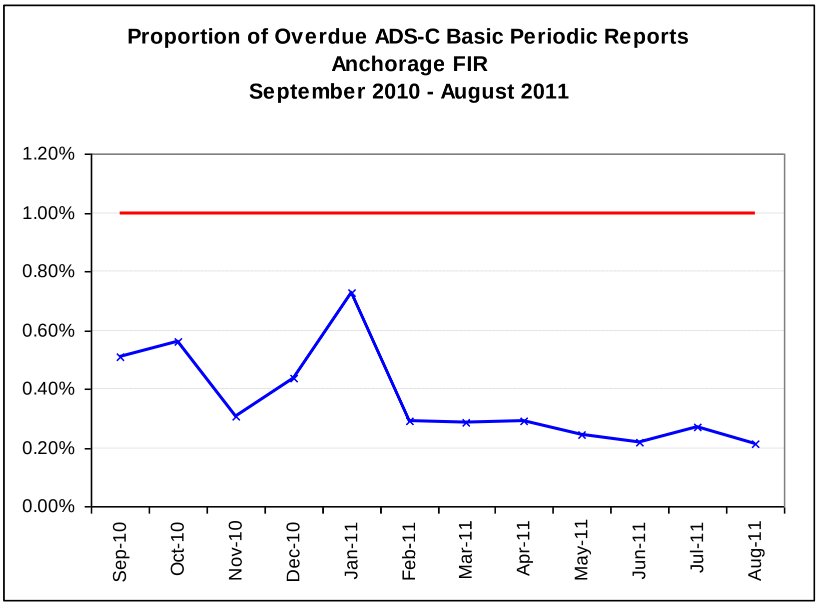

Figure 4. Proportion of Overdue ADS-C Periodic Reports Observed in Anchorage Airspace

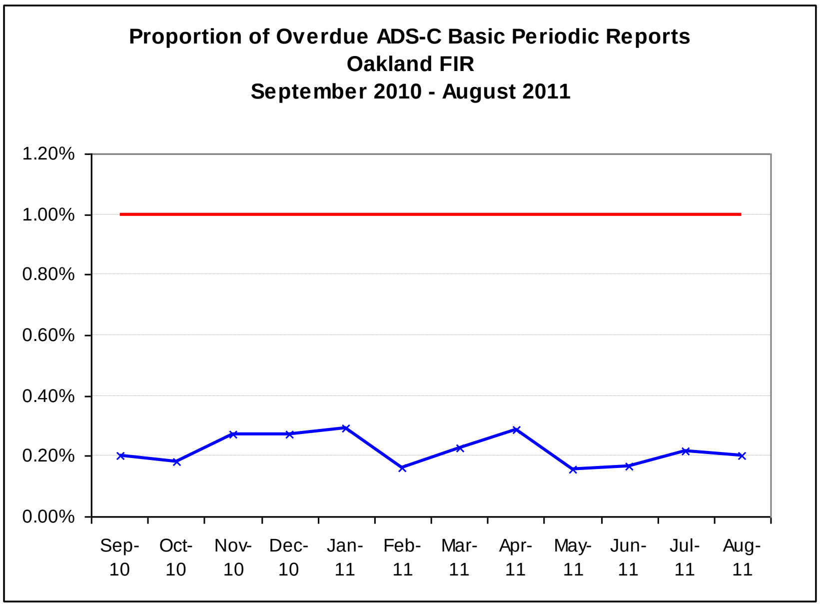

Figure 5. Proportion of Overdue ADS-C Periodic Reports Observed in Oakland Airspace

6.2 The data in Figure 4 shows that the average proportion of missing ADS-C reports in the Anchorage FIR is 0.36 percent. A spike in the proportion of overdue ADS-C reports was observed in January 2011. There were no reported communication outages during the month of January 2011. However, several of the observed overdue ADS-C reports were expected around the same time. These data might indicate a degradation or unreported outage within the communication infrastructure. The data in Figure 5 shows that the average proportion of missing ADS-C reports in the Oakland FIR is 0.22 percent

6.3 Appendix A provides a summary of the observed performance of the operational data link system at Anchorage and Oakland Oceanic Centers. The purpose is to compare the measured performance obtained from analysis of the operational data to the criteria specified in the Global Operational Data Link Document (GOLD) (reference 3). The data link performance analysis for the Anchorage and Oakland FIRs uses data collected for the time period July through December 2011.

6.4 These data are relevant to the application of the reduced horizontal separation standards in oceanic airspace because both the communication and surveillance systems which are necessary to support these separations rely on data link.

6.5 The data in Appendix A show that the observed data link performance in both Anchorage and Oakland for the top 90 percent of operators meets the 95 percent criteria for the ACP, ACTP, and ADS-C latency established in the GOLD. Several of the operators are meeting the 99.9 percent criteria.

7. MONITORING OF THE APPLICATION OF THE REDUCED HORIZONTAL SEPARATION STANDARDS

7.1 The PARMO regularly monitors the application of the reduced horizontal separation standards through the available archived data. The monitoring activities are performed in conjunction with a scrutiny group established to review the performance of the systems supporting the reduced separation standards. The scrutiny group was established prior to the first introduction of the reduced horizontal separation standards in the Oakland FIR in 2005. The scrutiny group consists of representatives from the Flight Standards Services office, Anchorage and Oakland ARTCC, Aircraft Certification Service, En-route and Oceanic Air Traffic Procedures office, and the FAA Technical Center.

7.2 The PARMO monitoring activities include an examination of the filed RNP4 status from operations conducted within the airspace and comparisons of the RNP4 status to the RNP4 approval records. The PARMO has formally established RNP4 and RNP10 approval records for operators/aircraft types contained within the PARMO RVSM approvals database.

7.3 Other monitoring activities include evaluation of weather deviations requests, overdue ADS-C periodic reports, longitudinal speed error, communication and surveillance system performance, and reported LLD and LLE occurrences. The evaluation of weather deviation requests and missing ADS-C periodic reports includes the verification of certain automation features of the decision-support tools within Ocean21.

7.4 The data accumulated from monitoring of the longitudinal speed error is used to estimate this distribution for use in the collision risk model. Archived ADS-C position reports are used to examine the longitudinal speed error. This is done by matching the actual waypoint position report to each aircraft-provided position estimate. The speed error is computed from the difference between the actual position time and the estimated position time.

8. ESTIMATE OF HORIZONTAL COLLISION RISK FOR PACIFIC AIRSPACE

8.1 Estimation of lateral collision risk

8.1.1. The estimation of the lateral risk takes into account the various traffic flows in the Anchorage and Oakland FIRs. The various traffic flows are described in Table 4. The proportions of eligible RNP10 and RNP4 operations vary within each traffic flow as does the aircraft operators, aircraft type populations, fixed or user-defined airways, and traffic volumes. The fixed airways in the North Pacific (NOPAC), Central Pacific (CENPAC) – which includes the Pacific Organized Track System (PACOTS), and the Central East Pacific (CEP) routes have relatively higher lateral occupancy values.

Table 3. Traffic Flows Used in Anchorage and Oakland Lateral Collision Risk Estimate

Sub-Region of Pacific	Flow	Description of Flow
North Pacific	NOPAC	North America west to Japan/Korea/beyond plus Japan/Korea to and from Alaska and beyond
	Central Pacific (CENPAC)	Japan/Korea/other Asian origins east to North America
	Central East Pacific (CEP)	North American mainland to and from Hawaii
	Hawaii/Japan	Japan/Korea to and from Hawaii
	Japan/Guam	Japan/Korea to and from Guam/Saipan/other proximate destinations
	Other	All other North Pacific flights not covered above
South Pacific and Pacific trans-equatorial	SOPAC	Australia to and from airports in northern hemisphere; New Zealand to and from airports in northern hemisphere

8.1.2. The estimate of lateral collision risk has calculated in a similar manner as the vertical risk. The same and opposite lateral occupancies were estimated to be 0.07814 and 0.02598, respectively. The 50NM lateral separation standard was used as the basis for this calculation.

8.1.3. Figure 6 provides the 50NM lateral collision risk estimates for each month during the current reporting period. Each monthly risk estimate was 'weighted' by the estimated number of flight movements in each Pacific airspace flow.

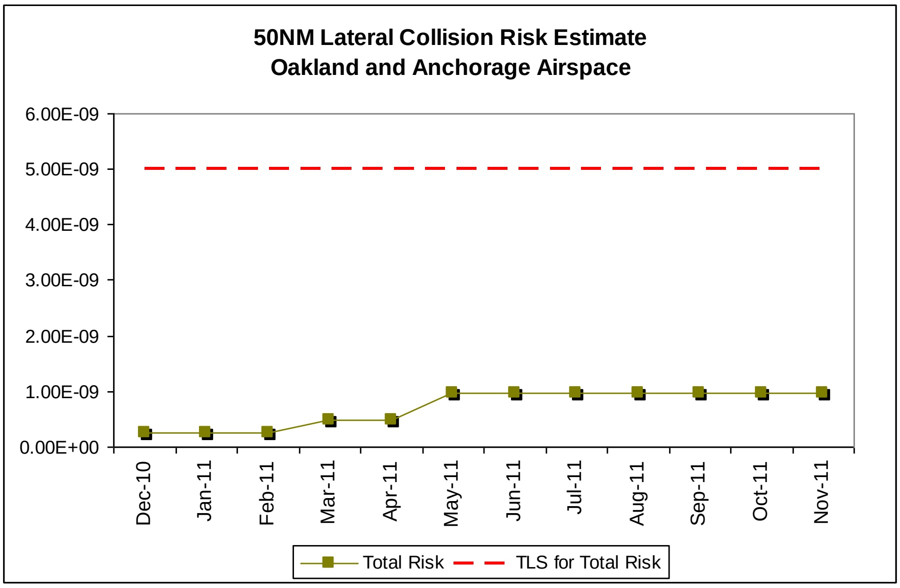

Figure 6. 50NM Lateral Collision Risk for Anchorage and Oakland Airspace

8.1.4. The data in Figure 6 show that the estimated lateral collision risk value satisfies the target level of safety (TLS) applicable to judging the safety of the lateral separation standard, 5.0×10^{-9} fatal accidents per flight hour due to the loss of planned lateral separation. Table 4 provides a summary of the data.

Table 4. 50NM Lateral Collision Risk Estimates for Pacific Airspace

Portions of Pacific Airspace *– estimated number of traffic movements= 380,000 operations (note: estimated number of traffic moments is based on the December 2010 traffic sample data)*			
Source of Risk	**Lower Bound Risk Estimation**	**TLS**	**Remarks**
Total Risk	0.963×10^{-9}	5.0×10^{-9}	Below Overall TLS

9. ACTIONS BY THE MEETING

9.1 The meeting is invited to

a) note the information contained in this paper, and

b) discuss any relevant matters as appropriate.

References

1. "Report of the Seventh Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/7)," International Civil Aviation Organization, Bangkok, Thailand, June 2007.
2. *ICAO Asia Pacific Region En-Route Monitoring Agency (EMA)*, ICAO Asia Pacific Office, Version 2, August 2010 Edition, Bangkok, Thailand.
3. *Global Operational Data Link Document (GOLD)*, ICAO, 1st Edition, 14 June 2010.
4. "CPDLC/ADS-C Data Link Performance Monitoring", PARMO, RASMAG/13, WP20, Bangkok, Thailand, August 2010.

Appendix A

A. Observed Data Link Performance

A.1. This section provides a summary of the observed performance of the operational data link system at Anchorage and Oakland Oceanic Center. The purpose is to compare the measured performance obtained from analysis of the operational data to the criteria specified in the Global Operational Data Link Document (GOLD) (reference 3).

A.2. The performance data observed from the CPDLC system is assessed against the Required Communication Performance (RCP) 240 specification when sent via satellite or VHF and against the RCP 400 specification when sent via HF. The latency performance data observed from the Automatic Dependent Surveillance - Contract (ADS-C) system is measured against the Type 180 specification when sent via satellite or VHF and the Type 400 specification when sent via HF. The purpose of this analysis is to demonstrate that safety objectives which rely on the communications infrastructure can be met by the aircraft and ground systems. The sample period of July through December 2011 was examined for the Anchorage and Oakland FIRs.

A.3. The GOLD provides the guidance material describing the required data points from the FANS 1/A aircraft communications addressing and reporting system (ACARS) messages. The GOLD also describes the calculation process for the actual communication performance (ACP), actual communication technical performance (ACTP), pilot operational response time (PORT), and ADS-C surveillance latency.

A.4. Figure A-1 through A-3 provides the ACP, ACTP, and ADS-C surveillance latency performance, respectively, during the time period July through December 2011 for the Oakland oceanic FIR. The data presented include data link communications through all available media types; satellite, VHF, and HF. Table A-1 provides a summary of the observed data link usage by media type for the Oakland FIR.

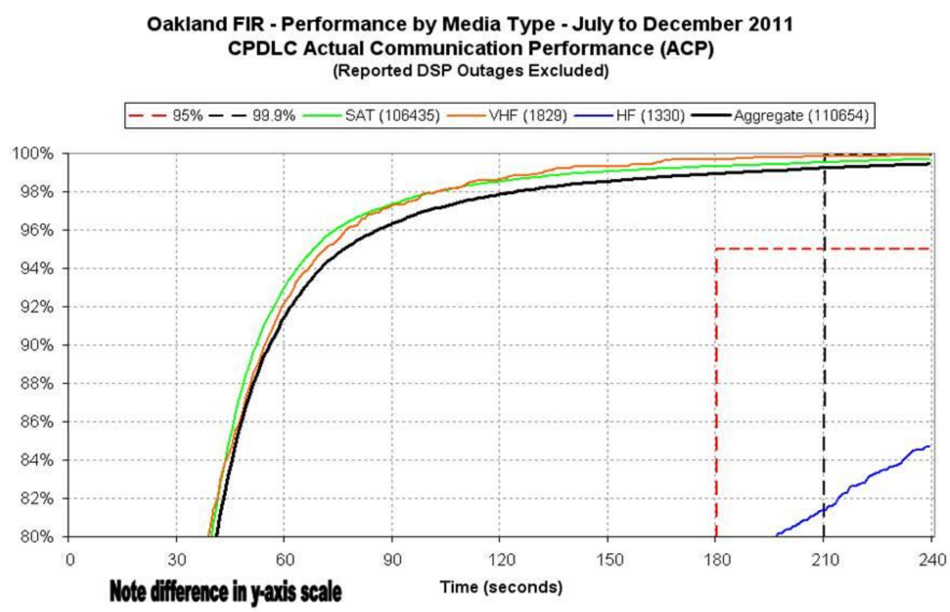

Figure A-1. ACP Observed for All CPDLC Transactions in the Oakland FIR – July through December 2011

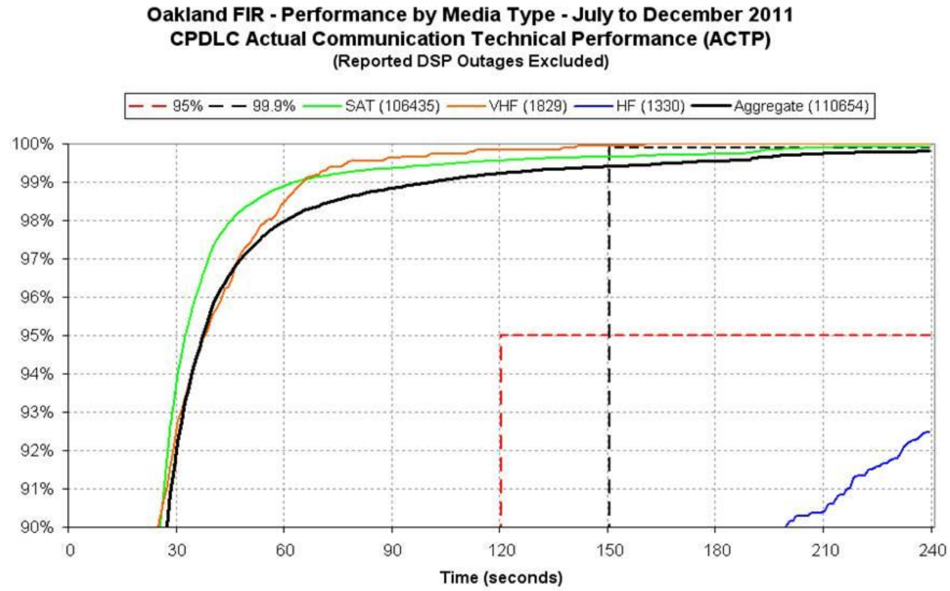

Figure A-2. ACTP Observed for All CPDLC Transactions in the Oakland FIR – July through December 2011

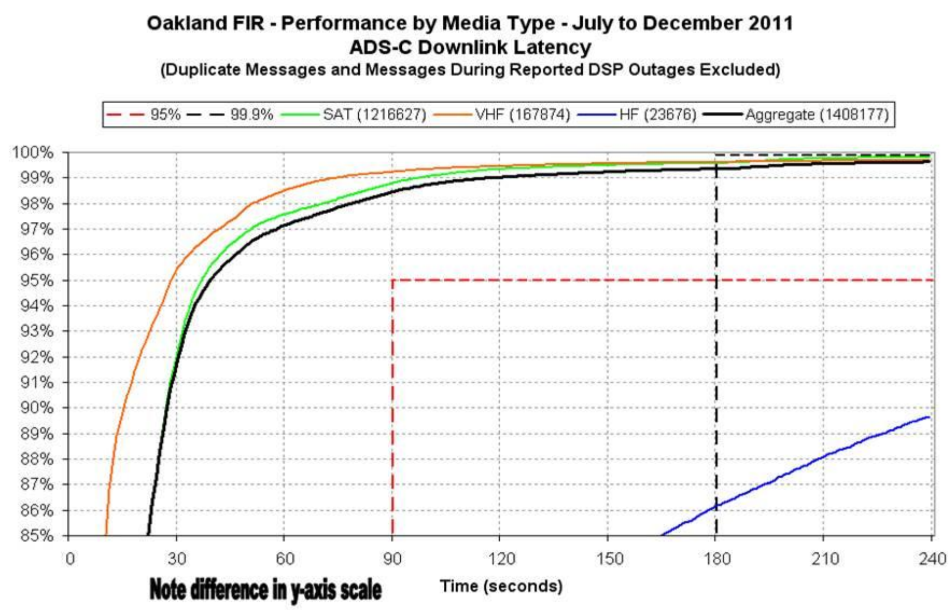

Figure A-3. ADS-C Surveillance Latency Observed for All ADS-C Downlink Transactions in the Oakland FIR – July through December 2011

Table A-1. Summary of Observed Data Link Media Usage – Oakland FIR

Media	Percent of ADS-C Messages	Percent of RCP CPDLC Messages
SAT	86.4%	96.2%
VHF	11.9%	1.6%
HF	1.7%	1.2%
Mixed Media	--	1.0%

A.5. The data shown in Figures A-1 through A-3 show that the data link transactions made using satellite and VHF meet the 95 percent criteria for RCP240 ACP, ACTP and RSP180 ADS-C surveillance over the six-month period. The data also shows that HF data link performance does not meet the RSP400 95 percent criteria for ADS-C surveillance or the RCP400 95 percent criteria for ACP during the six-month period. The data provided in Table A-1 show that the majority of the data link communication messages are sent via satellite data link in the Oakland FIR.

A.6. Figure A-4 through A-6 provides the ACP, ACTP, and ADS-C surveillance latency performance, respectively, during the time period July through December 2011 for the Anchorage oceanic FIR. The data presented include data link communications through all available media types; satellite, VHF, and HF. Table A-2 provides a summary of the observed data link usage by media type for the Anchorage FIR.

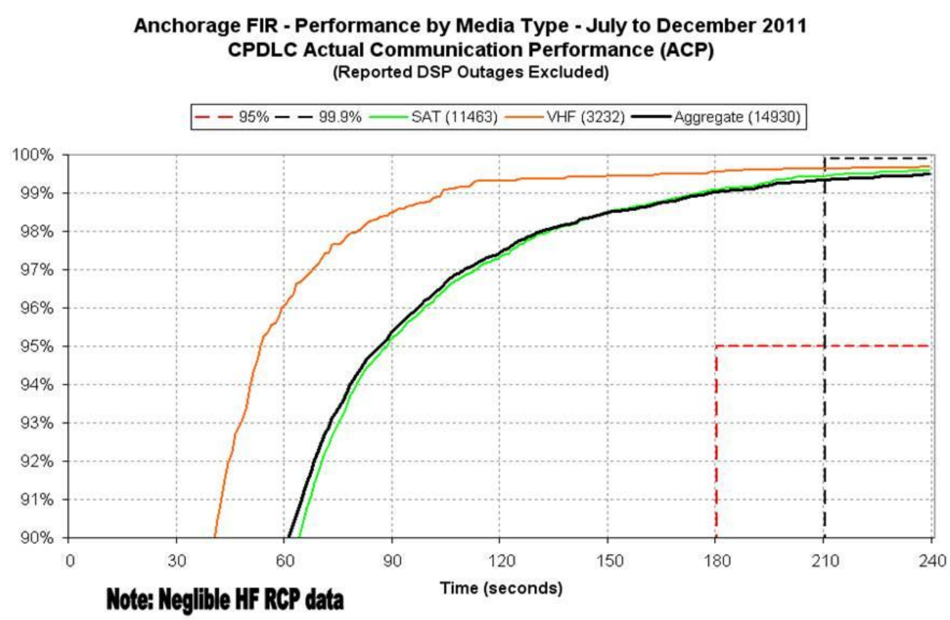

Figure A-4. ACP Observed for All CPDLC Transactions in the Anchorage FIR – July through December 2011

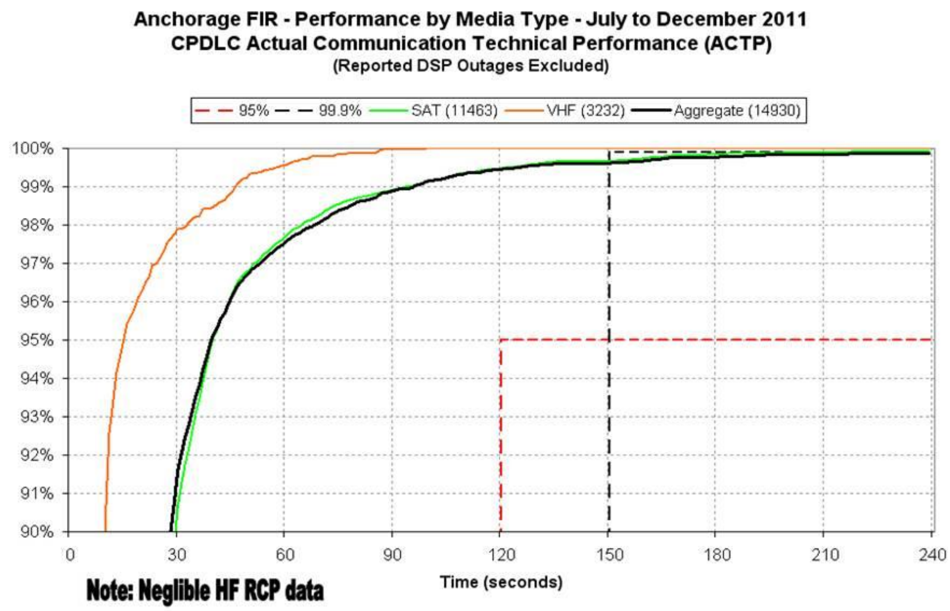

Figure A-5. ACTP Observed for All CPDLC Transactions in the Anchorage FIR – July through December 2011

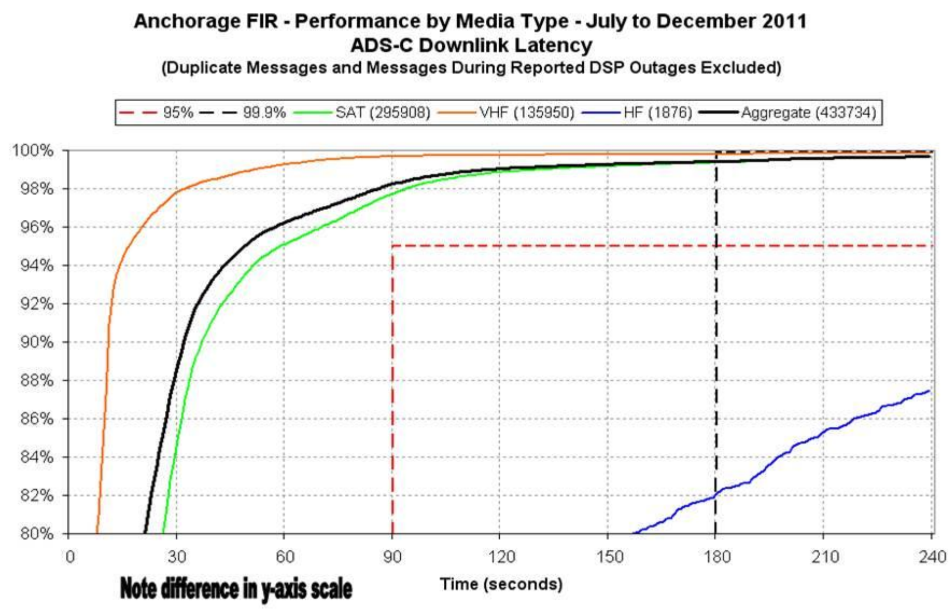

Figure A-6. ADS-C Surveillance Latency Observed for All ADS-C Downlink Transactions in the Anchorage FIR – July through December 2011

Table A-2. Summary of Observed Data Link Media Usage – Anchorage FIR

Media	Percent of ADS-C Messages	Percent of RCP CPDLC Messages
SAT	68.2%	76.8%
VHF	31.3%	21.6%
HF	0.5%	0.0%
Mixed Media	--	1.6%

A.7. The data shown in Figures A-4 through A-6 show that the data link transactions made using satellite and VHF meet the 95 percent criteria for RCP240 ACP, ACTP and RSP180 ADS-C surveillance over the six-month period. There is a negligible number of CPDLC messages sent using HF data link during the sample period within the Anchorage FIR. The data provided in Table A-2 show that the majority of the data link communication messages are sent via satellite data link in the Anchorage FIR.

A.8. The top 90 percent of operators in the Oakland FIR in terms of number of CPDLC and ADS-C data link messages are presented in Table A-3. The operator information is de-identified in the Table. Values that appear in **blue** indicate that the 99.9 percent target level was attained. Values that appear in **red** indicate that the 95 percent target level was not reached.

Table A-3. RCP240 and RSP180 Performance Observed in the Oakland FIR by Operator

Operator	% of ADS-C	ADS-C 95%	ADS-C 99.9%	% of CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
A	14.72%	98.29%	99.48%	12.64%	99.22%	99.42%	98.92%	99.31%	95.12%
D	9.34%	98.53%	99.60%	6.69%	99.45%	99.62%	99.46%	99.59%	97.50%
B	7.44%	99.02%	99.54%	7.30%	99.41%	99.53%	99.15%	99.43%	97.99%
L	6.27%	98.84%	99.69%	7.14%	99.28%	99.42%	98.47%	98.92%	95.44%
G	5.97%	99.72%	99.83%	10.48%	99.84%	**99.88%**	99.74%	99.80%	99.28%
Q	5.89%	98.54%	99.55%	5.82%	99.21%	99.52%	99.46%	99.61%	97.97%
E	4.00%	99.21%	99.61%	3.70%	99.66%	99.76%	99.56%	99.71%	98.68%
NNN	3.86%	**88.99%**	94.30%	3.07%	**90.75%**	92.63%	**87.77%**	90.31%	**83.44%**
O	3.50%	99.20%	99.79%	2.95%	99.79%	**99.91%**	99.85%	**99.97%**	98.56%
F	3.39%	99.37%	99.83%	5.55%	99.92%	**99.93%**	99.74%	99.82%	99.09%
J	3.39%	99.63%	**99.88%**	4.89%	99.85%	99.85%	99.72%	**99.89%**	99.17%
M	2.98%	98.06%	99.17%	2.18%	99.25%	99.54%	99.13%	99.46%	97.80%
H	2.82%	99.57%	99.82%	4.54%	99.72%	**99.88%**	99.84%	**99.96%**	98.98%
N	2.59%	99.44%	99.59%	1.84%	99.21%	99.26%	99.02%	99.46%	98.62%
T	2.42%	99.19%	99.69%	3.00%	99.61%	99.73%	99.49%	99.61%	98.67%

Operator	% of ADS-C	ADS-C 95%	ADS-C 99.9%	% of CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
S	2.40%	98.60%	99.43%	1.73%	99.79%	**99.90%**	99.63%	99.69%	98.12%
K	2.22%	98.65%	99.27%	2.54%	99.15%	99.25%	99.36%	99.75%	98.11%
R	2.16%	98.36%	99.52%	2.07%	99.56%	99.65%	99.65%	**99.96%**	97.91%
Y	2.10%	97.89%	98.83%	0.79%	98.85%	99.08%	98.51%	98.85%	97.14%
V	1.45%	99.84%	**99.89%**	1.35%	100.0%	**100.0%**	99.93%	**100.0%**	99.60%
ZZZZ	1.36%	98.74%	99.20%	0.82%	99.12%	99.12%	96.70%	97.03%	**86.70%**

A.9. Further analysis was done on the data collected for Operator NNN which showed that the observed satellite and VHF data link meet at least the 95 percent criteria for all the RCP240 and RSP180 performance measures. The observed HF data link performance for operator NNN did not meet the 95 percent criteria for RCP400 or RSP400. Data from operator NNN was further examined to observe the data link performance by airframe, there were three airframes in the data sample with noticeably below average performance.

A.10. The top 90 percent of operators in the Anchorage FIR in terms of number of CPDLC and ADS-C data link messages are presented in Table A-4. The operator information is de-identified in the Table. Values that appear in **blue** indicate that the 99.9 percent target level was attained. Values that appear in **red** indicate that the 95 percent target level was not reached.

Table A-4. RCP240 and RSP180 Performance Observed in the Anchorage FIR by Operator

Operator	% of ADS-C	ADS-C 95%	ADS-C 99.9%	% of CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
Q	12.51%	98.14%	99.52%	12.40%	99.19%	99.57%	99.08%	99.41%	95.30%
D	11.18%	98.04%	99.59%	6.62%	99.49%	99.60%	99.29%	99.70%	96.66%
S	8.63%	98.31%	99.64%	8.46%	99.45%	99.68%	99.05%	99.29%	96.12%
A	7.82%	97.10%	99.36%	7.37%	99.82%	**99.91%**	98.91%	99.45%	**93.64%**
Y	7.58%	95.12%	97.17%	3.41%	97.64%	97.64%	96.07%	97.05%	**93.71%**
L	7.56%	99.02%	99.69%	7.68%	99.56%	99.56%	98.95%	99.30%	**94.16%**
F	7.19%	98.99%	**99.87%**	10.08%	99.34%	99.60%	99.60%	99.80%	98.14%
H	6.32%	99.21%	99.62%	8.94%	99.85%	**99.93%**	99.40%	99.70%	97.83%
R	4.05%	96.82%	99.54%	3.76%	99.47%	99.64%	98.93%	99.29%	95.90%
J	3.64%	99.89%	**99.93%**	5.71%	100.0%	**100.0%**	99.88%	**99.88%**	99.30%
G	3.54%	99.69%	**99.90%**	5.46%	99.75%	99.75%	99.51%	99.63%	98.53%
P	2.71%	98.42%	99.52%	3.45%	99.03%	99.22%	97.86%	98.25%	92.62%

Operator	% of ADS-C	ADS-C 95%	ADS-C 99.9%	% of CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
T	2.62%	98.73%	99.53%	3.01%	98.89%	99.11%	99.33%	99.33%	97.56%
QQQ	2.41%	99.26%	99.52%	3.05%	99.78%	**100.0%**	99.78%	99.78%	98.90%
M	2.37%	98.00%	99.46%	1.90%	99.65%	99.65%	97.53%	97.88%	95.41%

A.11. Table A-4 shows that fifteen of the top operators in the Anchorage FIR meet the 95 percent criteria for the ACP, ACTP and ADS-C surveillance latency. All but three of these operators meet the 95 percent criteria for PORT. In addition, a few of the operators also meet the 99.9 percent criteria for the ACTP, ACP, and ADS-C surveillance latency in the Anchorage FIR.