Twenty Fifth Meeting of the
Informal South Pacific ATS Co-ordinating Group (ISPACG/25)

Honolulu, Hawaii, USA, 24-25 March 2011

Agenda Item 4: Review Open Action Items (AI 21-2)

STATUS UPDATE FOR DEVELOPMENT AND IMPLEMENTATION OF ADS-C CLIMB DESCENT PROCEDURE

Presented by the Federal Aviation Administration

SUMMARY

This information paper provides an update on development and implementation of operational trials for the use of the ADS-C Climb Descent procedure.

1. INTRODUCTION

1.1. The Federal Aviation Administration (FAA) has been developing a new oceanic air traffic control (ATC) procedure, termed Automatic Dependent Surveillance–Contract (ADS-C) Climb Descend Procedure (CDP). ADS-C CDP utilizes existing user equipage and ATC capabilities to allow more oceanic flights to achieve their preferred vertical profiles. ADS-C CDP is part of the Oceanic Trajectory Based Operations (OTBO) program, a critical Next Generation Transportation System (NextGen) capability that addresses current performance gaps in the area of capacity, productivity, and efficiency in the oceanic environment. Integral to ADS-C CDP is the use of advanced communication, navigation, and surveillance (CNS) capabilities; e.g., ADS-C, Controller-Pilot Data Link Communications (CPDLC), and Required Navigation Performance (RNP).

2. DISCUSSION

2.1. The ADS-C CDP is modeled after in-trail distance measuring equipment (DME) rules in International Civil Aviation Organization (ICAO) Doc 4444, paragraph 5.4.2.3.2. Aircraft pair distance verification is performed by Ocean21, using near simultaneous ADS-C demand contract reports. As with the existing DME procedure, responsibility for separation assurance remains with ATC.

2.2. To analyze the benefits associated with the procedure, ADS-C CDP is being demonstrated in an operational trial by manually applying ADS-C CDP requirements without changes to Ocean21 and will be limited for use between RNP-4 qualified aircraft. Based on a benefits analysis conducted in 2007, it is expected that the ADS-

C CDP could be applied once or twice per day in the operational trial. If the operational trial validates the benefits of the procedure (based on the number of opportunities to apply the procedure), the controller checks that are done manually for the trial will implemented as an enhancement to Ocean21 software, as an automated procedure.

2.3. A hazard analysis of the ADS-C CDP was performed by a panel of experts that included personnel with operational and technical backgrounds. This analysis utilized approaches from the FAA's Safety Management System Manual (SMSM) and identified six potential hazards that could occur during normal execution of ADS-C CDP. Additionally, four potential hazards that could occur if ADS-C CDP is not executed within the normal requirements were identified and evaluated. These hazards were identified to have a low initial risk.

2.4. A Safety Risk Management Panel (SRMP) was formed to discuss and consider potential hazards applicable to the proposed operational trial. Based on the existing controls and the implementation of the recommended safety requirements that the panel identified, it was deemed by the group that this procedure could be safely executed in an operational trial.

2.5. A collision risk model was developed and performed in support of the ADS-C CDP operational trial within the Oakland Flight Information Region (FIR). The model for "Estimating the Probability of Collision during the Execution of an In-Trail Procedure," is available for review at Attachment B.

2.6. The procedure being utilized for the operational trial will allow qualified aircraft to climb or descend through the altitude of a blocking aircraft. All current separation standards still apply. The controller will have a checklist for the manual procedure in the operational trial to ensure that a set of criteria are met before applying the procedure. ADS-C CDP requirements are as follow:

a) The maneuvering aircraft is flying level prior to executing ADS-C CDP.

b) The maneuvering aircraft is approved for RVSM.

c) The maneuvering aircraft has active FANS-1/A ADS-C and CPDLC connections.

d) The blocking aircraft is in level flight.

e) The blocking aircraft is approved for RVSM.

f) The blocking aircraft has active FANS-1/A ADS-C and CPDLC connections.

g) The blocking aircraft has an assigned altitude that is 1,000 feet above or below maneuvering aircraft assigned flight level.

h) Blocking and maneuvering aircraft are same direction traffic.

i) Blocking and maneuvering aircraft are eligible for ADS 30/30 distance-based separation.

j) Neither the maneuvering nor blocking aircraft are on a deviation from course or are requesting a deviation from course.

k) Neither the maneuvering nor blocking aircraft are out of conformance.

l) The maneuvering aircraft will execute an altitude change of at least 2000 feet.

m) For a manual operational trial, maneuvering and blocking aircraft must be qualified and approved for RNP-4.

2.7. For the manual operational trial of ADS-C CDP, the following criteria are being used:

a) The controller must set RNP-4 distance-based separation flags for the maneuvering and blocking aircraft.

b) ADS-C CDP can be used when the Conflict Probe results for the requested altitude change show a conflict, and either of the following two distance and speed checks is passed.

1) When the maneuvering aircraft is probed for an altitude change, the blocking and maneuvering aircraft display an ACTUAL conflict (NOW indicated in red, to the right of "LOS" in the Conflict Report Window), and all of the following checks are satisfied:

- The longitudinal separation distance at the conflict start time is greater than or equal to parameter (16) nautical miles (NM).
- The leading aircraft groundspeed is greater than or equal to the trailing aircraft groundspeed, based on the displayed groundspeeds after ADS DEMAND reports are received.
- The leading aircraft reported Mach number is greater than or equal to the trailing aircraft reported Mach number.

2) When the maneuvering aircraft is probed for an altitude change, the blocking and maneuvering aircraft have an ACTUAL or IMMINENT conflict (Red box will be displayed to the right of "LOS" in the Conflict Report Window), and all of the following checks are satisfied:

- The longitudinal separation distance at the conflict start time is greater than or equal to parameter (26) NM.
- The trailing aircraft groundspeed is greater than the leading aircraft groundspeed by at most parameter (10) knots, based on the displayed groundspeeds after ADS DEMAND reports are received.
- The trailing aircraft reported Mach number is greater than the leading aircraft reported Mach number by at most parameter (.02).

c) The predicted longitudinal separation distance must be obtained from the Conflict Report.

d) ADS-C CDP shall not be used if there are ACTUAL or IMMINENT conflicts with other aircraft at the blocking altitude or CDP target altitude.

e) The uplink clearance shall be a CPDLC message:

1) CLIMB TO REACH (a*lt)* by *(time)*

2) DESCEND TO REACH (*alt*) by *(time)*

Note: *(time) is* a parameter (15) minutes after the uplink time of the ADS Demand message for the maneuvering aircraft.

2.7. The operational trial of ADS-C CDP began on 15 February 2011.

2.8. The operator Notice to Airmen (NOTAM) for the ADS-C CDP trial is available for review at Attachment A.

3. ACTION BY THE MEETING

3.1. The meeting is invited to note the information in this paper and at the attachments.

Attachment A: ADS-C CDP Operator NOTAM
Attachment B: Model for "Estimating the Probability of Collision during the Execution of an In-Trail Procedure"

ATTACHMENT 1

Oakland Oceanic Control Area (CTA)

Operational Trials for

Automatic Dependent Surveillance – Climb Descend Procedure (ADS-C CDP)

1. Introduction. Effective15 February 2011, Oakland Air Route Traffic Control Center (ARTCC) will apply reduced longitudinal separation aircraft-to-aircraft during altitude change maneuvers between appropriately authorized and equipped aircraft throughout the Oakland Oceanic CTA.

The ADS-C CDP was conceived as a result of industry and FAA collaboration to allow appropriately certified and authorized oceanic flights to safely climb or descend thru the altitude of a blocking aircraft to achieve more optimal flight levels over long distance flights; thus, reducing fuel burn and environmental impact. In addition, the ADS-C CDP provides Air Traffic Control (ATC) with an additional instrument to aid in the most effective and efficient movement of air traffic.

The FAA developed the new ADS-C CDP oceanic ATC procedure to utilize existing user equipage and ATC capabilities to allow more oceanic flights to achieve their preferred vertical profiles. Integral to ADS-C CDP is the use of advanced communication, navigation, and surveillance (CNS) capabilities; e.g., ADS-C, Controller-Pilot Data Link Communications (CPDLC), and Required Navigation Performance (RNP). To apply ADS-C CDP, oceanic controllers will utilize manual procedures, as well as Ocean21 automation system capabilities developed for the Advanced Technologies and Oceanic Procedures (ATOP) program.

This procedure is based on in-trail Distance Measuring Equipment (DME) rules in ICAO Doc 4444, paragraph 5.4.2.3.2. Aircraft pair distance verification is performed by Ocean21, using near simultaneous ADS-C demand contract reports. As with the existing DME procedure, responsibility for separation assurance remains with air traffic control.

To achieve early benefits, ADS-C CDP will be demonstrated in operational trials by manually applying ADS-C CDP requirements without changes to Ocean21 and will be limited for use between RNP-4 qualified aircraft. Upon conclusion of the operational trial, ADS-C CDP may be implemented as an enhancement to Ocean21 software as an automated procedure.

Figure 1 shows a basic depiction of the associated procedure. During execution of the procedure, the controller is responsible for ensuring separation with all aircraft at the blocking altitude and target CDP altitude by using the ATOP/Ocean 21 conflict probe decision support tool. Lateral, longitudinal and vertical separation minima for aircraft not eligible for ADS-C CDP will not change.

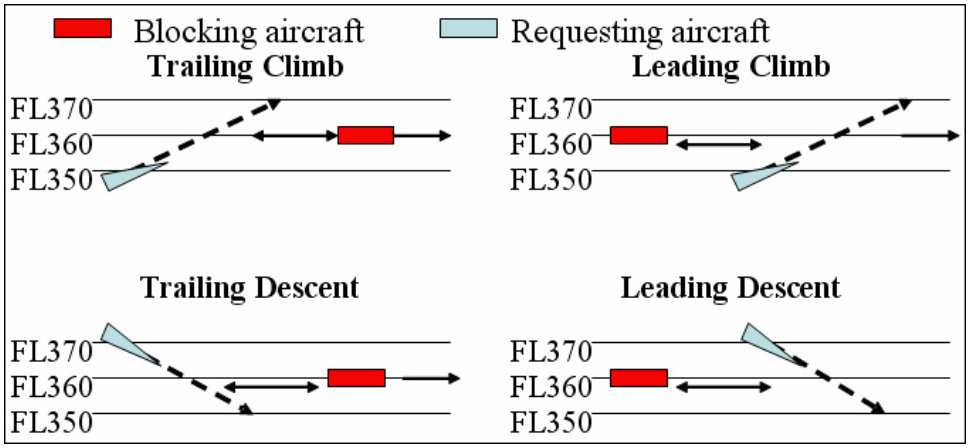

Figure 1: ADS-C Climb Descend Procedure

This notice provides operational policies, requirements and recommendations for operators planning for ADS-C CDP in the Oakland Oceanic CTA. The notice is posted on the "Pacific Comm/Nav/Surveillance (CNS) Requirements/Options" webpage that is linked to the Oceanic and Operations homepage: http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enroute/oceanic/

Operator requirements for the application of 30nm lateral/30nm longitudinal separation and 50nm longitudinal separation are not addressed in that they have been previously published.

2. FAA Planning for ADS-C CDP. The FAA will assess safety and operational issues during the operational trial. When those issues are successfully addressed, the FAA will consider expansion of ADS-C CDP operational trials into other US-controlled oceanic airspace.

3. Enabling Technology -- FANS-1/A Aircraft Systems and Advanced Technologies and Oceanic Procedures (ATOP)/Ocean21.

- **FANS 1/A Capabilities.** Aircraft FANS-1/A communications, navigation and surveillance (CNS) capabilities, interfaced with Ocean21, are required in order for ADS-C CDP separation to be applied.
- **Ocean21 capabilities**. FAA's ATOP program uses the Ocean21 system for integrated communication, surveillance and air traffic management. Ocean21 enhanced capabilities are required for application of ADS-C CDP separation in oceanic airspace where the FAA provides ATS. Ocean21 provides oceanic air traffic controllers with a set of automated decision support tools to assist in aircraft separation assurance, coordination, flight data management and controller-pilot communication. Ocean21 enhanced ATS automation capabilities are enabled by integrating ADS-C and conventional position reports, system-maintained electronic flight data, controller-pilot datalink communication (CPDLC), flight data message processing, automated interfacility and intrafacility coordination, automated conflict prediction and reporting (CPAR), graphic dynamic situation display to

the controller and interactive electronic flight strips, aircraft labels and aircraft position symbols.

4. Use of ADS-C CDP. Oakland ARTCC will apply ADS-C CDP separation to "targets of opportunity" throughout the Oakland Oceanic CTA. "Targets of Opportunity" are proximate pairs of aircraft that are eligible for ADS-C CDP separation. To allow qualified aircraft to climb or descend through the altitude of a blocking aircraft when less than standard separation exists ADS-C CDP requirements are as follows:

- Maneuvering and blocking aircraft are qualified and approved for RNP-4.
- Maneuvering and blocking aircraft have active FANS-1/A ADS-C and CPDLC connections.
- Maneuvering aircraft is flying level prior to executing ADS-C CDP.
- Blocking aircraft is flying level.
- Blocking aircraft has an assigned altitude that is 1,000 feet above or below maneuvering aircraft assigned flight level.
- Maneuvering and blocking aircraft are on same track, same direction.
- Maneuvering and blocking aircraft are eligible for distance-based separation.
- Neither the maneuvering nor blocking aircraft are on a deviation from course or are requesting a deviation from course. Strategic Lateral Offset Procedure (SLOP) allows aircraft to be laterally offset right of route up to 2 NM. SLOP is a normal oceanic procedure. A lateral offset is not estimated to affect ADS-C CDP.
- Neither the maneuvering nor blocking aircraft are out of conformance.
- Maneuvering aircraft will execute an altitude change of 2000 feet.

Minimum ADS-C-based lateral and longitudinal separation between 30/30 eligible aircraft and Required Navigation Performance 10 (RNP 10) aircraft remains unchanged. Lateral and longitudinal separation standards applied between RNP-10 and non-RNP aircraft also remains unchanged.

5. Operator Flight Planning. Other than the flight plan annotation requirements discussed in paragraph 10, application of ADS-C CDP does not affect operators' planning processes or procedures for filing flight plans.

6. Operational Benefits. The oceanic ADS-C CDP procedure is a controller-initiated procedure in response to a request from an aircraft for a change of level that can only take place with reduced separation minima to16 nm. The standard rules would require 30 nm or more separation between the climbing or descending aircraft and the aircraft at intermediate flight levels. Reducing the required separation criteria should result in many more available opportunities that will allow the controller to climb or descend aircraft to their desired efficient flight levels. By utilizing ADS-C CDP in oceanic airspace the FAA looks to achieve the following preliminary objectives:

- Reduce the number of blocking conditions by temporarily reducing the separation minimum thus increasing the opportunities that allow aircraft to transition to their preferred altitudes. Altitude changes are primarily expected to be climbs to maximize fuel efficiency but may include changes for turbulence avoidance, etc.
- Compute a preliminary estimate of fuel savings for oceanic operations.

7. **Safety Benefits**. The oceanic ADS-C CDP procedure requires enhanced CNS capabilities in air traffic systems and on board the aircraft. Enhanced air traffic surveillance systems provide controllers with automated tools such as conflict prediction and reporting to assist in separation assurance and with tools to better monitor flight plan conformance. Enhanced communication and surveillance systems also enable controllers and pilots to better communicate and manage weather deviations and contingency situations such as aircraft turn-backs and diversions.

8. **ADS-C CDP Requirements for Aircraft and Operators.** For aircraft/operators to be eligible for application of ADS-C CDP, the following requirements must be met:

- The aircraft and operator must be authorized by the State of the Operator or the State of Registry, as appropriate, for RNP-4 operations;
- The aircraft must be equipped with a FANS-1/A package (or equivalent) that includes satellite CPDLC and ADS-C that meet the standards of RTCA Document 258 (*Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications*);

9. **References for Operational Policy and Procedures**. Operational policy/procedures documents related to this trial are posted on the "Pacific CNS Requirements/Options" webpage. (See paragraph 1)

10. **ADS-C CDP Flight Planning Requirements.** To inform ATC and to key Ocean21 automation that they have appropriate authorizations and are eligible for ADS-C CDP, operators must annotate the ICAO Flight Plan as follows:

- Item 10 (Communication, Navigation and Approach Equipment) must be annotated with letters "J" (Data Link), "R" (Required Navigation Performance) and "Z" (additional information in Item 18).
- Item 10 (Surveillance Equipment) must be annotated with "D" (ADS Capability);
- Item 18 (Other Information) must be annotated with "NAV/RNP4".

11. **ADS-C CDP In-Flight Environment.** Pilots should be aware that during the trial, ADS-C CDP can be applied to their aircraft. They should use all available tools to maintain an awareness of other aircraft in their proximity in case an in-flight contingency occurs (e.g., aircraft or ATC system malfunction).

12. **Contacts**

ATC questions or comments should be directed to:

- John Mineo, Manager, Oceanic and Offshore Operations, FAA Headquarters; Phone 202-385-8322; Email: john.mineo@faa.gov
- Karen Chiodini, Oceanic and Offshore Operations, FAA Headquarters. Ph 202-385-8931; Email: karen.l.chiodini@faa.gov
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(Oceanic and Offshore Operations, AJE-32)

ATTACHMENT 2

[Model for "Estimating the Probability of Collision during the Execution of an In-Trail Procedure" provided as a separate file.]