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Agenda Item 2: WATRS Plus Project Implementation Issues

SUMMARY OF THE U.S. FAA WATRS PLUS SAFETY ASSESSMENT DOCUMENT

(Presented by the United States)

SUMMARY

This Working Paper provides a summary of the safety assessment document developed by the U.S. FAA Separation Standards Analysis Group for the WATRS Plus Project. It discusses the assessment methodology used and the sources for analyzed data. It concludes that the lateral risk estimate for WATRS Plus operations will be below the ICAO endorsed Target Level of Safety of 5 x 10-9 fatal accidents per flight hour.

ICAO Strategic Objectives:
A: Safety – Enhance global civil aviation safety
D: Efficiency – Enhance the efficiency of aviation operations
E: Continuity – Maintain the continuity of aviation operations

Global Performance Indicators:
GPI-5 - Performance Based Navigation
GPI-6 - Air Traffic Flow Management
GPI-7 - Dynamic and flexible ATS route management
GPI-8 - Collaborative airspace design and management
GPI/9 - Situational Awareness
GPI/17 - Implementation of Data Link Applications

1. Introduction

1.1 In 1995, the network of routes currently in use was implemented in WATRS airspace. Today, these routes bear approximately 300,000 operations per year resulting in about 825,000 annual flight hours. It is a complex route network that has sustained an average annual traffic increase of 2.8 percent since the last route structure redesign. The airspace is poised for further growth as economic activity increases in the Caribbean and in South America as well as sustaining traffic growth trends for all of oceanic airspace.

1.2 This paper provides a summary of and conclusions from the "*Safety Assessment to Support Use of 50 NM Lateral Separation Standards in the Western Atlantic Route System (WATRS) Plus Control Areas*". The Safety Assessment was developed by the Separation Standards Analysis Group at the U.S. FAA William J. Hughes Technical Center. The Safety Assessment evaluates the risk of collision expected to prevail at and after implementation of the WATRS Plus Route Structure Redesign and

Separation Reduction. It presents a description of current traffic and using that as a basis, it provides simulation results that project an increased traffic demand on the new system of routes. It then uses that projection to estimate the lateral passing frequency for a future system. The analysis then estimates the parameters of the ICAO-endorsed collision risk model in order to estimate the risk of collision.

3. Safety Assessment Summary

3.1 Assessment Methodology. The Safety Assessment consists of estimating the risk of collision which will pertain when the 50NM lateral separation standard is applied in WATRS airspace and comparing this risk to the specified Target Level of Safety (TLS). The ICAO endorsed TLS that applies to the lateral dimension is 5×10^{-9} fatal accidents per flight hour. Estimation of collision risk in this safety assessment is carried out using the general collision risk model, as described in the *Manual on Airspace Planning Methodology For the Determination of Separation Minima*, First Edition (Doc 9689-AN/953).

3.2 Major Inputs to Collision Risk Model. The major inputs to the Collision Risk Model are listed below. The FAA safety analysts evaluated each in developing the WATRS Plus Safety Assessment:

3.2.1. Normal "Core" Navigation Performance. This is a projection of normal, expected navigation performance in the airspace. The WATRS Plus aircraft population is projected to navigate within 7NM of cleared route centerline on a 95% containment basis. This projection was based on sampling of the navigation equipment indicator filed with the flight plan and was developed considering that approximately 40% of aircraft will meet the minimum navigation requirement of RNP 10 while approximately 60% are expected to meet operator-option RNP 4, primarily due to GPS equipage.

3.2.2. Frequency of Gross Navigation Errors (GNEs). The analysts examined the National Airspace Incident Monitoring System and Aviation Safety Reporting System databases for the periods March 2002 to September 2007 to determine the number of navigation errors equal to or greater than 25NM (one-half the 50NM lateral separation minimum). They then used safety data collected between June 2006 and September 2007 to estimate the frequency of GNE occurrence in the current operational system. GNEs of 25NM or greater were estimated to occur at a rate of one event every 48,700 flights.

3.2.3. Lateral Occupancy. Lateral occupancy is a measure of relative packing of aircraft within the airspace. It was projected through simulation modeling for a period 5 years in the future with traffic demand increased according to U.S. FAA Aviation System Forecasts. Vertical and horizontal occupancy estimates were calculated by counting the number of aircraft that passed each other in opposite and same directions within the new WATRS Plus route structure with 50 NM lateral separation applied.

3.3 Estimation of Lateral Risk and Comparison to the TLS.

3.3.1 Using a projected lateral navigational performance of 7NM/95% containment, under the parameters outlined in the Safety Assessment and using collision risk model parameter estimates contained therein, the estimate of lateral collision risk is 0.32×10^{-9} fatal accidents per flight hour due to the loss of planned lateral separation. Given the current range of operations seen in the WATRS Plus airspace, this estimate of lateral collision risk yields an expectation in the interval of 3,500 - 4,400 calendar years between accidents.

3.3.2 If it is assumed that aircraft population performance just meets RNP 10 performance (10 NM/95% containment), the resulting estimate of lateral collision risk is 1.11×10^{-9} fatal accidents per flight hour due to the loss of planned lateral separation. Likewise, under the same set of assumptions, this estimate of lateral collision risk yields an expectation in the interval of 1,000 – 1,250 calendar years between accidents.

3.3.3 Both of these values satisfy the ICAO endorsed TLS value applicable to judging the safety of the lateral separation standard, 5×10^{-9} fatal accidents per flight hour due to the loss of planned lateral separation. Thus, the initial implementation with an RNP 10 minimum navigational requirement is projected to be below the threshold and in future when the lateral navigational performance approaches or exceeds 7NM/95% containment, additional risk tolerance will be provided to offset expected traffic growth.

4. Follow Up Actions

4.1 Pre-implementation Safety Assessment Update. The WATRS Plus implementation plan was developed by the WATRS Plus Task Force. It calls for GNEs to be reviewed and the Safety Assessment updated in March 2008 to assist U.S. FAA managers in making the final decision to implement 50 NM lateral separation on 5 June 2008.

4.2 Post-Implementation Tracking/Monitoring. The WATRS Plus Task Force implementation plan calls for a WATRS Plus monitoring program to be implemented to assess technical and operational problems, including GNEs, in the post-implementation period. The monitoring program would evaluate: the frequency and causes of GNEs, measures to mitigate the re-occurrence of such errors and any other operational or technical problems.

5. Data Sources Used for the Safety Assessment

5.1 FAA Enhanced Traffic Management System

5.1.1 The FAA's Enhanced Traffic Management System (ETMS) provides the means of applying air traffic management principles to traffic movements in the U.S. National Airspace System, as well as in oceanic airspace delegated to the FAA. The FAA Technical Center assembled all available ETMS records pertaining to operations in WATRS airspace for the 105-day period from 01 December 2005 through 15 March 2006 to assist in the safety assessment. In order to ensure that the WATRS Plus operations had not significantly altered since the original sample was taken, a follow-up sample of ETMS data was compiled for the period 20-26 February 2007 and compared with the ETMS data from the same week in 2006.

5.1.2 Information common to all ETMS records consists of the month and day of the record, the Universal Coordinated Time (UTC) at which the record was generated, the facility – FAA enroute control center or non-FAA communications center – originating the record, identification of the flight to which the record pertains, and origin and destination airports of the flight.

5.2 Radar Measurements of Aircraft Position

5.2.1 ETMS data were combined with the radar data for a 150 day period. By using the time and position information in each data source, it is possible to match the ETMS flights to the radar traces. This combination creates a data source with highly accurate position information along with identifying information about each flight.

5.3 Safety Databases

5.3.1 A group of FAA databases, collectively called the National Airspace Incident Monitoring System (NAIMS), contains information regarding all reported instances of errors of an operational nature made by flight crews or air traffic controllers, with such reports being compulsory for FAA personnel witnessing such errors. In addition, the U.S. National Aeronautics and Space Administration (NASA) administers the Aviation Safety Reporting System (ASRS), a database of similar incident reports, with reporting being non-compulsory and the identity of reporters being kept anonymous.

5.3.2 The Technical Center assembled all reports from NAIMS and ASRS for the period of March 2002 through September 2007 for use in elaborating the extent of gross navigation errors (GNE) in the WATRS region. From these, an estimate of the proportion of GNEs was made and that is used in the preparation of the overall navigational distribution employed in the safety assessment.

5.4 Ocean21 Archived Data. The Ocean21 automation system became fully operational in June 2006 at the New York Oceanic ARTCC (ZNY). Since this time, the system operations experts at ZNY have provided the Technical Center with all of the archived Ocean21 operations data. These data consist of the aircraft flight plans, and electronic aircraft position reports (HF, CPDLC, and ADS-C messages) provided from the comprehensive data reduction and analysis capabilities of Ocean21. An example of each is shown in the Safety Assessment. The flight plan portion of these messages contains key information regarding the carriage of navigational and other equipment that was filed by the operator. These data are used to indicate the expectation of meeting various RNP types by each operator/aircraft type.

6. Analysis of Data Retrieved from Safety Databases

6.1 As noted previously, the NAIMS and ASRS safety databases were examined for the period of March 2002 through September 2007 in a search for events of possible importance to the application of the 50NM lateral separation minimum. The search criteria used in this examination were made broad deliberately in order to minimize the possibility of missing such events. As a consequence, all WATRS reports from NAIMS were examined initially for the stated period. Search criteria for ASRS reports were “link,” “ocean,” “CPDLC,” “Atlantic” and “WATRS.”

6.2 A close examination of the data revealed a difference in the rates of occurrence of these key reports before and after the implementation of the Ocean 21 system at ZNY on 6 June 2006. Ocean21 is not thought to have caused an increase in the number of events, but rather a more stable estimate of the frequency of occurrence of the events due to the availability of additional data. The Ocean21 system provides alerts and feedback to the controllers not previously available, thus leading to event reports that may have been overlooked in the past. In order to reflect the current operational system, the safety data collected between June 2006 and September 2007 were used to estimate the frequency of occurrence of GNEs in this risk analysis.

6.3 The events of interest in the risk assessment are those with a lateral magnitude greater than or equal to half of the separation minimum or 25NM. Using estimates of traffic activity derived from the analysis of approximately 800 operations per day (toward the lower end of the number of daily flights observed) and 487 days as the data collection period for the GNEs yields 389,600 as the sample interval number of operations. So, the lateral events are estimated at a rate of one event in every 48,700 flights.

7. Categorization of GNEs. The Safety Assessment analysis of safety databases found the following GNEs of 25 NM or greater:

a) Four events where the pilot flew filed or flight planned route rather than cleared route
b) Two events where the pilot flew direct rather than cleared route
c) One event where the pilot flew did not fly the cleared route of flight due to a communication breakdown between the pilot and controller
d) *One event where the pilot deviated to avoid weather without being able to obtain an ATC clearance.

**Note: weather deviation events were included in the analysis of risk bearing events. It should be recognized, however, that in a weather deviation event the pilot is knowingly deviating from track to avoid weather. It is not a pilot navigation "blunder" error. In addition, operator programs include pilot training on "Weather Deviation Procedures". These procedures enable the pilot to mitigate the risk of conflict with other aircraft when the pilot is unable to obtain an ATC clearance and is forced to maneuver the aircraft to avoid weather. Weather Deviation Procedures are published in Chapter 15 of ICAO Document 4444 (Air Traffic Management).*

8. Existing Controls To Mitigate GNE Occurrence

8.1 The following controls are not addressed in the Safety Assessment, but are existing controls that mitigate the occurrence of GNEs:

8.1.1 Operator in-flight operating drills are required that include mandatory cross checking procedures to identify navigation errors in sufficient time to prevent inadvertent aircraft deviation from cleared route centerline.

8.1.1.1 References include: FAA Order 8400.12 (as amended) (RNP 10); FAA Order 8400.33 (as amended) (RNP 4); the ICAO Performance Based Navigation Manual, Volume II and the North Atlantic MNPS Airspace Operations Manual, Chapters 13 and 14.

8.2. ATC provides procedural surveillance of aircraft intent data to verify aircraft adherence to cleared flight plan profile.

8.3. Ocean21, the ATC automation system used in the New York Oceanic CTA/FIR, provides route conformance checking logic that notifies the controller if the next or next plus one waypoints do not match the cleared flight plan profile

9. Conclusion

9.1 The Safety Assessment developed by the U.S. FAA Separation Standards Analysis Group shows that given prevailing conditions and expected performance, the WATRS Plus Route Redesign and Separation Reduction will meet international guidelines for implementation.

9.2 A summary of the Safety Assessment document will be posted on the WATRS Plus Webpage which is linked to the Oceanic & Offshore Operations Homepage:

www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enroute/oceanic/

9.3 In addition, the full Safety Assessment document will be made available on request in accordance with the directions published in the proposed amendment to CAR and NAT Regional Supplementary Procedures.

10. Suggested Actions

10.1 The group is invited to:

a) Consider the safety assessment methodology and data sources used in the U.S. FAA WATRS Plus Safety Assessment document, as well as, the conclusions reached.

b) Endorse posting a summary of the Safety Assessment document on the WATRS Plus Webpage and making the full Safety Assessment available on request in support of the proposal to amend CAR and NAT Regional Supplementary Procedures (Doc 7030) to enable implementation of 50 NM lateral separation in the WATRS Plus Control Areas.

- END -