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EXPERIMENT AND IMPLEMENTATION OF REGIONAL NAVIGATION (RNAV) FLIGHT PROCEDURES IN CHINA

(Presented by China)

SUMMARY

This paper presents information on the design, experiment and implementation of flight procedures for regional navigation in China.

1. INTRODUCTION

1.1 With a view to promoting the development and evolution of aeronautical navigation and flight procedures, enhancing airspace capacity and flight efficiency, ICAO has published technical guidance material on area navigation/required navigation performance (RNAV/RNP), so as to encourage the application and implementation of RNAV by member States. With the rapid growth of air transport, the flight volumes of major routes and aerodromes in China have increased rapidly, the congestion of aerodromes and routes has deteriorated, and the workload of flight crew and air traffic controllers has increased significantly. There is an increasingly urgent need to improve flight efficiency and utilization of aeronautical facilities. The application of RNAV is an effective measure to improve airspace utilization, flight efficiency and flight safety level and to alleviate the workload of pilots and controllers. Therefore, China has shown positive reactions to the recommendations of ICAO in promoting the application of RNAV in the airspace of China.

2. DEVELOPMENT STRATEGY FOR FLIGHT PROCEDURES IN THE CIVIL AVIATION OF CHINA

2.1 Based on the medium and long term development plan for air traffic management in the Civil Aviation of China, the future flight procedure service in China will focus on RNAV/RNP, gradually phasing out the existing traditional procedures.

2.2 The application of RNAV technology will have significant impact on the future construction of navigation facilities, route structures and operations in terminal areas in China. At present, the philosophy followed by China in flight procedure design is to adopt the mature design specifications developed by ICAO and produce practical RNAV procedures with due consideration to the existing navaids and airborne avionics. The performance in the application of RNAV will be validated through experiments. On the basis of experiments, we will develop the design specifications for RNAV flight procedures in China, train technical personnel and push for nationwide application progressively.

2.3 In view of the layout of the existing navigation facilities and the policies in the application of satellite navigation in China, we believe that RNAV based on VHF omnidirectional radio range/distance measuring equipment (VOR/DME) and DME/DME is currently the appropriate navigation method in China, and that RNAV procedures using global navigation satellite system (GNSS) and small required navigation performance (RNP) value (0.3 or below) will be the focus for future research and development in China.

3. STATUS OF EXPERIMENT AND IMPLEMENTATION OF RNAV FLIGHT PROCEDURES

3.1 **Overview**: China commenced officially the design and experiment of RNAV approach and departure procedures in July 2001. Tianjin Haibin Airport was selected as an airport to conduct experiment for design, research and development of RNAV flight procedures after prudent assessment in April 2002. After investigation and research, design, assessment, training and flight tests, trial operation was carried out on 21 February 2003. The project was certified by the General Administration of Civil Aviation of China (CAAC) in July 2003, after nearly 5 months' trial operation. Later on, based on the design, research and development of RNAV flight procedures at Tianjin Haibin Airport, China designed RNAV flight procedures for the Capital Airport, and conducted flight tests in August 2003.

3.2 **RNAV flight procedures design**: Based on the available navaids at Tianjin Haibin Airport area, and taking into consideration the airborne equipment of the current fleet of Chinese airlines, China designed RNAV procedures based on VOR/DME, DME/DME and GNSS. These procedures have identical nominal tracks, and appear to be the same procedures to pilots and controllers. However, they have different protection zones, and can be used by aircraft with different and updated equipment.

3.3 **Aircraft participating in the experiment**: Boeing 737-300 and 737-800 of Air China and Xin Hua Airlines participated in the flight tests for RNAV flight procedures at Tianjin Haibin Airport. Boeing 737-300 had basic RNAV capabilities, were equipped with basic airborne equipment such as VOR/DME receiver, inertial navigation system (INS) and flight management computer (FMC); Boeing 737-800 had GNSS navigation capabilities, in addition to RNAV capabilities.

3.4 **Development of track analysis tools for flight tests**: A software system to record radar tracks was developed to validate the accuracy of the flight tracks in using RNAV procedures. The system can record and process aircraft tracks and altitude as recorded by radar, assist in analysing the deviation of the aircraft from the nominal track, and give a visual and quantitative assessment to the actual performance of RNAV operation. After revision, the software system may be used in recording tracks displayed on secondary radars of various types in China and conducting analysis on experiment.

3.5 **Flight tests and trial operation**: Flight tests were conducted for RNAV flight procedures based on VOR/DME, DME/DME and GNSS, by using B737-300 and B737-800 of Air China and Xin Hua Airlines. With the data recorded by radar, analysis and assessment of the flight test result were carried out by using flight track analysis tools. It was found that the maximum difference between the theoretical nominal track and actual flight track was within 300 m. With the success in flight tests, Tianjin Haibin Airport proceeded with trial operation of RNAV in February 2003.

3.6 **CONCLUSIONS**

a) the RNAV flight procedures at Tianjin Haibin Airport facilitate operation by pilots and instruction by controllers, thus effectively alleviating the workload of pilots and controllers;

b) Boeing 737-300 is the most basic aircraft type in the transport fleet in China, their airborne equipment can meet the requirement of RNAV flight procedures. Therefore, it shows that RNAV flight procedures have a wide scope applicability in terms of the requirement for airborne equipment; and

c) RNAV is an innovation vis-à-vis the traditional method for flight procedures design. Its introduction will lead to full and efficient utilization of limited airspace resources and the existing navigation resources, improvement of en-route and terminal area operation environment, and enhancement of ATS quality.

4. **FUTURE WORK**

At present, China has completed RNAV flight procedures design and flight tests at Beijing Capital International Airport, on the basis of the RNAV experiments at Tianjin Haibin Airport. Other associated tasks such as airworthiness and operation certification are being actively prepared. In the near future, China will gradually implement RNAV flight procedures at the Tianjin Haibin Airport and the Beijing Capital International Airport. This move will significantly improve the operation efficiency of busy airports.

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