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GUIDANCE MATERIAL ON AREA NAVIGATION

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FOREWORD

The purpose of this Circular, which is published by authority of the Secretary General at the request of the Air Navigation Commission, is to provide preliminary guidance to States intending to exploit area navigation techniques in their air traffic management system, and to promote a measure of uniformity in their approach to this matter.

The guidance material contained herein was developed by the Seventh Air Navigation Conference, which met in Montreal, Canada, in April 1972. Taking note of the air navigation equipment in use at the time, the Conference considered that there was no need for international standardization of any particular type of equipment. It emphasized, however, the requirement for implementation and operation of area navigation equipment on a common, co-ordinated basis and, to that end, developed guidance material for the design features and operational characteristics of such equipment in terms of accuracy, reliability and operational capability. Additional guidance material, based on operating experience at the time, was developed in the fields of aviation communications, operations, airworthiness, air traffic services and aeronautical information services.

It was recognized that widespread implementation of area navigation might have considerable impact on current ATS procedures for air traffic on conventional routes and that the guidance material in this Circular would probably need to be extensively supplemented. The Conference therefore recommended that States with developing experience in the application of area navigation share their experiences and inform ICAO of any problems that have arisen together with suggestions for remedying them. The guidance material is expected to be reviewed on the basis of such experiences before the middle of 1976, in accordance with Recommendation 5/3 of the Conference.

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GUIDANCE MATERIAL ON AREA NAVIGATION1. Introduction

1.1 Operation in existing airspace route structures requires that aircraft adhere to designated flight paths leading either directly toward or away from a navigation aid, e.g. VOR/DME or NDB. This requirement imposes limitations on the configuration of the route structure and is one of the factors preventing the provision of additional routes in the airspace. The problems that arise for ATC from this lack of flexibility of the present route structure may be partly overcome by the use of radar; however, this is at the expense of increased radar controller workload.

1.2 These limitations are critical both in the en-route phase of flight and in relation to arrival and departure procedures, which involve climb and descent, since it is normal practice to rely on the same ground stations for both phases of flight with consequent concentrated funnelling effect.

1.3 A logical step toward providing more efficient use of airspace and aerodromes would be the use of navigation systems which would permit flight over predetermined tracks within prescribed accuracy tolerances without the need to fly directly over navigation aids. This capability, for which the term "area navigation" is used, would permit, for example, the following:

- a) Establishment of more direct routes between departure and arrival aerodromes to permit a reduction in flight distances;
- b) Establishment of dual or parallel routes along basic itineraries to accommodate a greater flow of traffic in the en-route phase of flight;
- c) Establishment of bypass routes for overflying aircraft in high density terminal areas to permit a smoother flow of traffic;
- d) Establishment of optimum arrival and departure routes to permit a smoother flow of departing and arriving traffic;

- e) Selection of optimum locations for holding patterns;
- f) Establishment of alternative routes designated in advance but used only at the initiative of ATC to expedite traffic flow;
- g) Assignment by ATC of non-designated tracks on an ad hoc basis to meet requests by pilots or to resolve particular traffic problems;
- h) Execution of instrument approaches or descents through cloud towards runways or at aerodromes not equipped with instrument approach aids;
- i) Establishment of specially designed procedures for short take-off and landing (STOL) and helicopter operations.

1.4 The potential applications outlined above would benefit both civil and military operators as well as the ATC system by permitting increased flexibility of operations. The advantages of area navigation would apply not only to controlled flights but also to uncontrolled flights, for which direct navigation between two points, or the selection of routes bypassing congested or restricted areas, together with elimination of the need to fly directly over navigation aids, are principal advantages. The extent of the advantages to be gained are dependent upon the extent and manner of application but are potentially very significant in terms of airspace capacity, operating costs, workload for pilots and controllers, and flight safety.

1.5 Although the following material deals only with navigation in the horizontal plane, it is recognized that a third dimension of control may be provided ultimately by the addition of a vertical guidance capability to the basic area navigation system.

2. Definitions

Area Navigation (RNAV) - A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

* Area navigation route - An ATS route established for the use of aircraft capable of employing area navigation.

* Amended to accord with Amendment 20 to Annex 11.

3. Descriptive elements

Area Navigation Equipment - Airborne equipment which provides the capability meeting the appropriately established criteria for area navigation.

RNAV Instrument Approach Procedure - A specified instrument approach procedure, suitably identified by an appropriate prefix, for use by aircraft with area navigation equipment.

RNAV Arrival Procedure - A specified procedure for use by aircraft with area navigation equipment for transition from an en-route way-point to the initial approach way-point of an instrument approach procedure or to a way-point from which a visual approach may be made.

RNAV Departure Procedure - A specified procedure for use by aircraft with area navigation equipment for transition from a designated point after take-off to an en-route way-point.

RNAV Reference Aid - A ground-based navigation aid used as a reference for the definition of a portion of an RNAV route or an RNAV procedure, and the associated waypoint(s).

Slant Range - The actual distance between an aircraft in flight and a reference aid, this distance being greater than the horizontal distance because of the level of the aircraft.

Slant Range Error - The difference between the slant range and the horizontal distance from the location of the reference aid to a point directly beneath the aircraft.

Tangent point - The point on the centre line of an RNAV route from which a line perpendicular to the centre line passes through the location of a specified RNAV reference aid.

Way-point - A specified geographical location used to define an RNAV flight path. Two subsequent way-points define an RNAV route segment or a portion of an RNAV procedure.

Change-over point - A specified point on an RNAV route expressed in terms of distance to the nearest way-points, at which change from one RNAV reference aid to another should be made to maintain compliance with the established accuracy requirements.

4. Airborne system requirements

4.1 System design

4.1.1 General

4.1.1.1 To assure compatibility with current flight deck procedures, area navigation systems should typically compute distances, bearings, and/or command guidance signals relative to way-points used to define RNAV route segments. The systems may also include pictorial displays.

4.1.2 Inputs

4.1.2.1 Area navigation systems may be designed to use a variety of inputs either from station-referenced aids, such as VOR/DME, or from self-contained aids such as inertial systems (or in combination). It is essential, however, that regardless of the inputs, compliance with the prescribed accuracy requirements can be demonstrated.

4.1.2.2 Automatic selection of the appropriate reference aid may be provided when a way-point is selected by means of a data storage and entry device. However, the selection of alternative station-referenced or other input must be possible by manual input to the system.

4.1.2.3 Selection of tracks other than those originally programmed must be possible by manual input to the system. The system should also incorporate offset capability by which the pilot can readily select tracks parallel to the basic RNAV route.

4.1.2.4 Checking of inputs

Provision should be made to enable the pilot to check the correctness of inputs.

4.1.3 Slant range error correction

4.1.3.1 Slant range error correction should be a function of airborne RNAV systems designed to use DME inputs.

Note. - If slant range error correction is not achieved within the airborne system, procedural measures involving larger protected airspace will be necessary to accommodate the flight path deviations which will occur.

4.1.4 Information output

4.1.4.1 Area navigation systems should provide continuous information on flight progress relative to the RNAV route and selected way-points, in a form meaningful to the pilot. They should give no operationally significant misleading information.