RTCA, Inc.
1140 Connecticut Avenue, NW, Suite 1020
Washington, DC 20036-4001 USA

Minimum Operational Performance Standards (MOPS) DGNSS Instrument Approach System: Special Category I (SCAT-I)

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FOREWORD

This document was prepared by RTCA Special Committee 159 (SC-159). It was approved by the RTCA Technical Management Committee on August 27, 1993.

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1.0 PURPOSE AND SCOPE

1.1 Introduction

This document contains Minimum Aviation System Performance Standards (MASPS) for a system to support differential GNSS (DGNSS) special instrument approaches. Initial applications of this system are anticipated to support Special Category I (hereafter termed "SCAT-I") precision approaches, which are specially authorized approaches made to MLS/ILS Category I minima with DGNSS used to provide navigation guidance. DGNSS special instrument approaches must be authorized by the FAA, using appropriate airworthiness and operational approval processes, based upon an aircraft operator's demonstrated capability and equipment as well as the availability of approved ground equipment. Such authorizations are expected to be made for specific aircraft approaching specific airports. For air carriers, these authorizations are expected to be made through modification to the carrier's operational specifications. For general aviation, these approvals are planned to be made through the issuance of a certificate of authorization.

The development of standards for DGNSS Instrument Approach Systems (DIAS) and subsystems has followed the Required Navigation Performance (RNP) concept. Primary RNP parameters are accuracy, availability, integrity, and continuity. These parameters are specified herein at the approach system level and then allocated to subsystems in this MASPS using a "risk tree" methodology as explained in Appendix K. Although the specific values of RNP parameters used in this document have been chosen to support SCAT-I operations, the system design principles used herein can be adapted to support DGNSS-based instrument approaches with both more and less stringent minima. The term "DIAS" will be used in discussions generic to systems supporting DGNSS Instrument Approach Systems. The term "SCAT-I system" will be used for a DIAS system specifically developed to support the RNP required for Special Category I approaches.

Incorporated within these standards are equipment characteristics that should be useful to users, designers, manufacturers, installers, and operators of the equipment. Functional specifications are used where possible in order that implementers may have flexibility in developing the DIAS equipment. This document is intended to support initial operational SCAT-I approaches within the National Airspace System in late 1993 or 1994.

Consistent with FAA guidance and the recommendations of the RTCA GNSS Task Force Report dated September 1992, the standards in this document are specifically oriented toward supporting early operational implementation. For example, the DGNSS data links specified have been chosen on the basis of three

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factors: current aircraft data link equipage that can be levered with minimal modifications; capability to perform the required functions; and the ability to support multiple service providers and low-cost SCAT-I system implementation. Since these standards have been developed to encourage early operational implementation of DIAS, refinements to these standards should be anticipated as operational experience is accumulated.

The format of this document generally follows that of an RTCA Minimum Operational Performance Specification (MOPS), with airborne equipment functional requirements having been developed using RTCA DO-208 as a model. However, a "traditional" MOPS is not appropriate for a DIAS, since ground equipment is specified as well as avionics. Ground equipment functional requirements have been in part developed from existing and planned FAA requirements for non-Federal precision approach systems. This document does not discuss requirements for runway lighting and environment, which are presumed to be equivalent to those for existing ILS approaches to corresponding minima.

Section 1.0 of this document provides system information and assumptions needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment applications and operational goals and forms the basis for the standards stated in Sections 2.0 through 4.0.

Section 2.0 contains system performance requirements and test procedures for a DIAS which supports SCAT-I approaches (i.e., a "SCAT-I system").

Section 3.0 contains requirements for both ground and airborne installed equipment performance.

Section 4.0 contains specifications for the operational characteristics of the SCAT-I system.

Normative Appendices to this document describe in detail the standard DGNSS message format (Appendix A), the SCAT-I system positioning accuracy error budget (Appendix B), the SCAT-I system continuity requirement (Appendix C), SCAT-I system integrity (Appendix D), SCAT-I system latency (Appendix E), the detailed characteristics of two DIAS DGNSS data links (Appendices F and G), and Class D equipment requirements (Appendix H: Class D equipment is defined in Section 2.0). These normative appendices have been developed to present the requirements involving a particular facet of SCAT-I system performance (e.g., integrity) in a unified manner, drawing material from pertinent Sections of the MASPS.

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Informative Appendices provide additional explanatory information on differential reference station survey techniques (Appendix I), tailoring the SCAT-I System design to the performance characteristics of specific aircraft, with examples of VDOP truncation and real-time SCAT-I airborne subsystem containment warning algorithms (Appendix J), the tunnel concept (Appendix K), and definitions (Appendix L). These appendices do not contain requirements.

1.2 System Overview

The DIAS consists of four distinct functional segments which provide navigation support. These functional segments are: 1) GNSS satellites providing positioning signals; 2) the DIAS airborne subsystem; 3) the DIAS ground subsystem; and 4) the DIAS data link.

The GNSS satellites provide the airborne and ground DIAS subsystems with positioning information. The ground subsystem produces ground-monitored differential correction, integrity and (optionally) precision approach waypoint data which is transmitted on the DGNSS data link to the airborne subsystem for validation and processing. The airborne subsystem then corrects its pseudorange measurements to each satellite with the differential correction data received from the ground subsystem to support more accurate determination of position, velocity, and heading. The differentially-corrected aircraft position is then used, in conjunction with approach waypoint data obtained from the airborne navigation data base and/or the DGNSS data link, to supply navigation guidance signals to drive appropriate aircraft systems such as displays, autopilots, and/or flight directors. A Total System Error (TSE) containment warning algorithm is executed in the airborne subsystem to provide additional system integrity.

1.2.1 GNSS Satellite Signals

The GNSS is a world-wide position, velocity, and time determination system, that includes one or more satellite constellations, receivers, and system integrity monitoring, augmented as necessary to support the required navigation performance for the actual phase of operation. In the time frame of initial SCAT-I approach implementation (1993-1994), it is anticipated that GPS will be the only GNSS constellation declared operational for civil use by the FAA. Complete deployment of the GLONASS constellation may take place by 1997. Additional ranging signals from geostationary satellites are also anticipated to be available in the future. The use of constellations additional to GPS for DGNSS instrument approach operations should be in conformance with both this document and pertinent sections of the 1993 RTCA SC-159 MOPS for GPS Augmented with Other Systems/Equipment/Techniques.

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