

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6 Aeronautical navigation
: issues

RNAV (GNSS) IMPLEMENTATION IN SOUTH AFRICA

(Presented by South Africa)

SUMMARY

To provide information on the RNAV (GNSS) trials and demonstrations currently in progress in South Africa (Project GROMET).

1. INTRODUCTION

1.1 The transition from conventional navigation aids to satellite navigation aids leads to a more complex scenario as concerns flight procedures design and validation. While the former is based on terrestrial based facilities, the latter has to rely on signals-in-space, provided by suitable satellite constellations as complemented by augmentation systems. The use of the global navigation satellite system (GNSS) signals, as part of the communications, navigation, and surveillance/air traffic management (CNS/ATM) system, for aircraft navigation leads to a new challenging task of the acceptance of instrument approach procedures based on satellite navigation systems. Contrary to the case of instrument procedures based on terrestrial based navigation aids, the point of origin of the signal, the satellites, are moving and the signal characteristics are a function of the satellite position. In this environment, flight measurements are strictly valid only at the time at which the measurement was taken.

1.2 The intention of the South African GNSS trials, GNSS area navigation (RNAV) Operations Manual Evaluation and Trials (GROMET) is to set out the working principles and procedures associated with GNSS procedures in order to achieve maximum results during the envisaged trial period. The commencement date of the GROMET trials was 28 December 2002 and will be extended up until training, legislation and ICAO Standards and Recommended Practices (SARPs) make it possible to implement on a permanent basis. In the absence of any RNAV (GNSS) legislation ATNS will enter into a Memorandum of Understanding (MOU) with each participating airline.

1.3 Discussion

1.3.1 The concept of RNAV is a significant enhancement in airspace design, use and management relating to navigation. It was developed by the International Civil Aviation Organization (ICAO) Special Committee on Future Air Navigation Systems (FANS) and is an integral part of the CNS/ATM plan envisioned by the Special Committee. FANS determined that the future CNS/ATM operating environment would stress RNAV and be based on navigation defined by geographic fixes and not restricted to terrestrial-based/source-referenced navigation aids defining specific points.

1.3.2 The starting point for the implementation of CNS/ATM systems, and consequently RNAV in South Africa, was the implementation of random routing operations over the Indian Ocean. This was followed by the development, trial and implementation of the fixed RNAV routes within South Africa. The next step towards full implementation is the development, trial and eventual implementation of standard terminal routings and non-precision approach procedures based on RNAV. To this end RNAV procedures based on GNSS were developed by ATNS for trial in Johannesburg, Durban and Cape Town. The trials started in December 2002.

2. AIMS AND OBJECTIVES OF GROMET

2.1 The aim of the South African RNAV (GNSS) trials, to be known as GROMET is primarily to test on board (aircraft) equipment for terminal control area (TMA) and non-precision approach (NPA) use which, will still be subject to SA-CAA certification and approval.

2.2 It must be noted that these trials are not intended to experiment with RNAV (GNSS) NPA's, although obtained data may be considered for the future development of RNAV (GNSS) approach procedures.

2.3 In addition to the aforementioned, the trial is intended to monitor, record and assess accuracy of GNSS position information, during this critical phase of flight.

2.4 It is intended to provide a suitable development environment in which training, evaluation, data collection and development work can be undertaken without compromising daily activities.

2.5 Data will be collected in defined periods to be processed into usable information and exchanged by all participants with the aim of collectively working towards implementation of the CNS/ATM system as defined in ICAO AFI Doc 003.

2.6 In addition to this, the objectives of the trial are inter alia:

- a) to familiarize air traffic control (ATC)'s and aircrew in RNAV (GNSS) TMA and NPA procedures;
- b) to obtain direct feedback from ATC and aircrew on the applications and any other aspects of RNAV (GNSS);
- c) to establish the requirements for RNAV (GNSS) NPA procedures through this pre-operational demonstration; and

- d) to obtain first-hand, factual data on the operational benefits, requirements, human factors, procedures and any problems which may be present during the use of RNAV (GNSS) within the defined areas.

3. METHODOLOGY

3.1 The intention is that, participating aircraft flying the RNAV routes take up the standard arrival route (STAR), based only on RNAV, with specific reliance on GNSS. and as published for this trial, completing the approach on the GNSS NPA, also as published for this trial, alternatively, completing the straight in approach, via the instrument landing system (ILS)?

3.2 Obviously the special phraseology must be used, as the STARS have not been re-named for the trials.

3.3 All aircrew and ATC involved with the trials have been appropriately briefed and are fully conversant with the procedures and phraseologies.

4. FLIGHT PROCEDURES

4.1 The following list depicts the instrument procedures for the GROMET trials.

4.2 In operational

RNAV(GNSS) RUNWAY 03R	FAJS
RNAV(GNSS) STAR RUNWAY 03	FAJS
RNAV(GNSS) RUNWAY 24	FADN
RNAV(GNSS) STAR RUNWAY 24	FADN
RNAV(GNSS) RUNWAY 01	FACT
RNAV(GNSS) STAR RUNWAY 01	FACT
RNAV(GNSS) RUNWAY 06	FADN
RNAV(GNSS) STAR RUNWAY 06	FADN
RNAV(GNSS) RUNWAY 19	FACT
RNAV(GNSS) STAR RUNWAY 19	FACT
RNAV(GNSS) RUNWAY 21R	FAJS
RNAV(GNSS) STAR RUNWAY 21	FAJS
RNAV(GNSS) RUNWAY 21L	FAJS
RNAV(GNSS) RUNWAY 03L	FAJS
RNAV(GNSS) SID RUNWAY 03	FAJS
GNSS(RNAV) SID RUNWAY 06	FADN
GNSS(RNAV) SID RUNWAY 24	FADN
GNSS(RNAV) SID RUNWAY 01	FACT
GNSS(RNAV) SID RUNWAY 19	FACT

5. AIRCRAFT REQUIREMENTS

5.1 The term “basic GNSS receiver” was developed to describe first generation GNSS receivers that at least meet the requirements of RTCA DO 208, SC-181, JAA TGL 3 or TSO-C129 certification standards. These documents specify the minimum performance standard that GNSS receivers must meet in order to comply with en-route, terminal area and non-precision approach procedures developed specifically for GNSS. The main requirement of these standards is for the GNSS receiver to have the following capabilities incorporated:

- a) integrity monitoring routines, for example receiver autonomous integrity monitoring (RAIM);
- b) turn anticipation; and
- c) capability for approach procedure retrieval from the read-only electronic navigation database.

Note.— Aircraft equipment is only one of the factors determining the use of required navigation performance (RNP) within certain air traffic management (ATM) situations and airspace.

6. LEGISLATION

6.1 In recognition of the complexities and requirements for a harmonized approach to the implementation of the CNS/ATM systems, ICAO has recommended the establishment of a national body. The national body is to facilitate and coordinate the implementation of the Africa-Indian Ocean (AFI) CNS/ATM plan through appropriate support for the activities of the various Implementation and Coordination Groups (ICG's) associated with the areas of routing. The South African Minister of Transport has established the National Body in the form of a Committee tasked to ensure harmonized implementation of regional and national CNS/ATM systems as contemplated in the various plans. The Committee comprises of specifically identified representatives from the national department of Transport, the SA CAA and ATNS. Legislation will be developed by the associated CNS/ATM systems workgroups, which will be formed by this body and then, obviously subjected to ratification by the South African Civil Aviation Authority, through its own process.

7. AIRCRAFT CERTIFICATION REQUIREMENTS

7.1 Airworthiness requirements will be contained in the RSA-CAA legislation on the installation and use of GNSS equipment. The legislation is currently under development, and work groups representing the industry, service providers and RSA-CAA will start to finalize the legislation. It is however foreseen that the following source criteria will be applied with some modifications:

- a) JAA Leaflet No. 3, Revision 1 dated 18 December 1997: JAA interim guidance material on airworthiness approval and operational criteria for the use of the NAVSTAR global positioning system (GPS);

- b) FAA TSO-C129a: Airborne supplemental navigation equipment using the global positioning system (GPS); and
- c) FAA AC 20-138: Airworthiness approval of global positioning system (GPS) navigation equipment for the use as a VFR and IFR supplemental navigation system.

7.2 It is foreseen that the maintenance procedures and technical standards be based on those in FAA AC 20-138.

8. AIR CREW AND AIR TRAFFIC CONTROL REQUIREMENTS

Aircrew.— The aircrew licensing requirements will also be contained in the RSA-CAA legislation currently under development. The proposed licensing requirement will address, among other, instrument rating endorsement, privileges and limitations, pilot training, recency requirements and training aircraft requirement.

Operational requirements.— The operational requirements will address, among other, pilot qualification, GNSS approaches, pre-flight requirements, flight plans, departure and arrivals, terminal operations, airborne navigation database requirements, and in respect of commercial air transport operations, compliance with approved operations specifications and training program's.

Air Traffic Service.— The ATS requirements deal, among other, with the training requirement for ATS personnel, procedures for ATS time recording devices to accommodate GNSS time standard, GNSS distance information to ATS units, separation adjustments, separation criteria (still under development by ICAO) and minima for lateral separation and notification of GNSS incidents.

9. CONCLUSION

9.1 Since the first project GROMET RNAV (GNSS) approach was flown at Johannesburg on 28 December 2002, 60 GNSS procedures have been flown at Johannesburg, Cape Town and Durban Airports at the time of publishing this paper. The trials got off to a slow start due to the fact that only one runway was available for GNSS approaches at each airport. The project has been extended to include all the other runways at all the three airports, and a much higher approach rate is being achieved since all the procedures have been implemented.

9.2 The feedback received from both the pilots and the controllers is positive, and no serious issues have come to light. The participation of our National Airline (South African Airways) has greatly enhanced the effectiveness of the trials, as the majority of their aircraft comply with the requirements to fly RNAV (GNSS) approaches. We foresee that participants in the GROMET trial will increase as the knowledge and equipment level increases and the word is spread throughout the aviation community, and we invite all qualifying airlines operating to and from South Africa to join the GROMET trials.

9.3 From the above it can be seen that South Africa is complying with the timelines as specified by the ICAO regional planning process.

9.4 The meeting is invited to take note of this information paper and to contact the National ATM/CNS Committee for further information.

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