

**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

**RLA/00/009 COORDINATION MEETING ON GNSS AUGMENTATION TRIALS**

(Santiago, 1 to 3 August 2001)

**Agenda Item 1: Analysis of the system for the GNSS augmentation trials, reference stations, master stations, avionics equipment and network configuration**

(Presented by the Secretariat)

**Summary**

This working paper describes, for the meeting's analysis and approval, the minimum requirements necessary for the installation of the reference stations, its components and the configuration of the trial augmentation network to mount in the CAR/SAM Regions.

**Reference:**

RLA /00/009 Project Document.

**1. Background**

1.1 As a first step towards the implementation of Regional GNSS augmentation, the Regional Office, through letter LN 3/19 SA327 of 9 March 2001, invited States participating in the GNSS augmentation project to establish a national multidisciplinary group composed by civil aviation technical and operational personnel.

1.2 At the moment, all States involved have formed their group and **Appendix A** to this paper includes information pertaining to each State's chief and counterpart of the group for the execution of the project.

1.3 As a next step, States where the reference stations would be installed were invited to proceed with the preparation of the site where the reference station would be located, providing all electrical and communications facilities necessary for the operation of the system.

1.4 The aforementioned was informed through the following communications sent by the South American Regional Office. First through letter LN 3/19 SA5206 of 20 February 2001, which sent the RLA/00/009 project document for analysis and approval and, later, through fax SA577 of 11 June 2001, which specified the arrangements to be made prior to installing the reference stations.

1.5 Likewise, to coordinate last details of the project, including the topology of the communications network to support the trials, a coordination meeting was held between FAA and ICAO at the William Hughes Technical Centre in Atlantic City, United States, from 26 to 27 April 2001.

## 2. Analysis

2.1 The reference stations should be installed before 30 September 2001 and, therefore, the States where the reference stations will be installed should have completed the following:

- Administrative arrangements for the temporary entrance of the equipment.
- Coordination with the local UNDP office.
- Site preparation.
- Establishment of the communications links.

2.2 **Appendix B** to this working paper presents the minimum requirements necessary for the site to house the reference stations. It describes the physical area necessary, the orientations for the site where the antenna will be installed, the electricity requirements and the environmental conditions.

2.3 In this respect, the meeting would have to inform the status of implementation at each of the States involved. Moreover, if there were any inconveniences in the implementation of any of the requirements described in Appendix B, it would be convenient to notify it to the meeting in order to find a solution.

2.4 The reference stations to be installed in Argentina, Bolivia, Colombia, Peru and a COCESNA State will count with the equipment described in **Appendix C** and shown in the block diagram in Figure 1 of this same Appendix.

2.5 The reference station alone will not provide precision, availability, continuity and seamlessness, it requires the presence of the master station, which will make the calculations necessary on the information from the reference station. The master station will generate the correction message, and the dissemination of the information to the users will be through a satellite link station to an Inmarsat geostationary orbit satellite or via VHF or UHF transmission.

2.7 The master stations have to be connected with a master station. For the CAR/SAM trials, there are two master locations located in Santiago de Chile and Rio de Janeiro, respectively. The communications network supporting the connections between the reference and master stations is shown in Appendix C (Figure 2).

2.8 To link the reference stations with the master station, communications circuits with a minimum band width of 19.2kb/sec are required. From the graphic in Appendix C, the distribution of the connections can be seen, observing that the reference stations of Colombia and COCESNA will connect with the Rio de Janeiro master station together with all of Brazil's reference stations (Brasilia, Curitiba, Manaus, Recife and Rio de Janeiro). In the same manner the Argentina, Bolivia and Peru reference stations will be connected to the Santiago de Chile master station, together with the other reference stations in Chile (Antofagasta, Balmaceda and Santiago).

2.9 The graphic in Appendix C shows a 128Kbits/sec link between the Santiago de Chile and Rio de Janeiro master stations. This configuration will permit both master stations to manage all the reference stations in the trial.

2.10 The correction message from the master station will be disseminated through the satellite link station located in Rio de Janeiro. This signal will be radio broadcasted at the same frequency of the GPS(L1).

2.11 Also, the correction of the GPS signal will be able to be radio broadcasted via a VHF or UHF transmitter, which will have a limited coverage around the site of its installation. **Appendix D** shows some recommended broadcasting equipment. The cost of the project does not include this equipment.

2.12 For flight procedure verification, the project will have a Cessna Citation II (DGCA Chile) and an HS-125 (DEPV Brazil), both equipped with GPS/WAAS avionics. The DGCA and DEPV will provide pilots and inspectors for both aircraft. The cost of the project includes fuel costs.

2.13 The States participating in the trial are invited to use these facilities. In the event that a State may wish to use its own flight inspection aircraft, it will have to be equipped with the avionics necessary to carry out the trial (GPS/WAAS). General information on the avionics segment is in Appendix G of the RLA/00/009 project document.

### 3. **Action recommended**

3.1 The meeting is invited to:

- a) Note the information presented in this working paper;
- b) Update the list of counterparts in Appendix A;
- c) Analyze the coordinations to be made with the UNDP Office. It is expected that at the end of the Meeting the participants have all the information necessary for the temporary importation of the equipment;
- d) Analyze the minimum requirements for the installation of the reference stations shown in Appendix B;
- e) Analyze and approve the communications network structure shown in Appendix C;
- d) Note the equipment necessary for local augmentation, shown in Appendix D; and
- e) Define which States participating in the Project will use the aircraft indicated in the RLA/00/009 project document (Page 19, Section 1.1 Supplies, page 20, Sections 1.3.2 and 1.3.3)

**APPENDIX A**

**RLA/00/009 PROJECT COUNTERPART COORDINATORS**

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## **APPENDIX B**

### **MINIMUM REQUIREMENTS NECESSARY FOR THE SITE TO HOUSE THE EQUIPMENT**

The establishment of these requirements will be the responsibility of the Administration.

#### **Physical Space**

- Each NSTB reference station requires space for one rack of equipment. The actual physical space required for one rack is 84 inches in height, 28.5 inches in width, and 26.5 inches in depth (84" H, 28,5" W, 26.5"D) (213,36 cm H, 72.39 cm W, 67,31 cm D).
- Additional space is required to allow access to the front and rear of an equipment rack for maintenance, as well as above the rack to permit adequate airflow and ventilation.

#### **Antenna Location**

- The antenna for each reference station must be located where permanent mountings to a structural member are available. These structures include steel catwalks, antenna towers, station walls or roofs.
- When determining the location of the antenna, the stability of the antenna mounting is very important. Platforms or towers as antenna mountings are OK as long as they are very solid (no sway) and have minimal effects from winds or regular foot traffic. This is important as the GPS position determined at the reference station is based on the antenna location, and if that location routinely moves around in wind, etc., the position solution will be degraded.
- The mounting of the antenna also must address the following:

- Obstructions must be minimized

An unobstructed 360 degree view of the horizon is desired, but this is not always practical.

Obstructions below 5 degrees in any azimuth are acceptable. For locations where obstructions above 5 degrees may exist, a review must be completed by the FAA before the site can be considered acceptable.

If an obstruction is in the field of view above 5 degrees, States need to provide details on the obstruction (i.e., large metal antenna support tower, approx. 100 feet tall, located at azimuth 45 degrees). Photos of the obstruction should also be provided (digital photos are best and easy).

- The antenna should be installed as far as possible from any transmitting source, even though no other transmitting antennas in the same band as the receiver are located near by.

- Another factor in the selection of antenna location is the maximum length of antenna cable to have satisfactory operation. The maximum distance between antenna and receiver should be 60 meters using an RG-213/214 type cable. A longer distance, not to exceed 80 meters, can be supported with a low loss type cable (i.e., heliax type).

#### **Power**

- The reference station requires one (1) 120 VAC –60 Hz –20 ampere circuit or one (1) 220VAC-50/60 Hz –10 ampere circuit with utilization of the step-down transformer provided.
- At locations where conditioned (critical) power is available, this shall be the source used.
- If conditioned power is not available, a source connected to a standby engine generator power is desirable.
- Connection direct to commercial power is the least desirable choice.

#### **Environmental Conditions**

- All equipment must be installed in an occupied building with a temperature range of 50-80 degrees Fahrenheit (F) (10° to 27° degrees Centigrade).

## **APPENDIX C**

### **EQUIPMENT AT THE REFERENCE STATION**

The reference station to be installed will have the following equipment, which will be sent by the FAA:

- One GPS Ashtech Z-12 receiver with respective antenna for external connection.
- One Rubidium oscillator.
- One multiport digital device (8 ports).
- One Sentry R 1000 Remote Power Manager.
- One DEC ALPHA processor with respective Software.
- Lan 10 BASE -T.
- One Cisco model 2514 router.

**Figure 1 – TO BE INCLUDED**

**Figure 2 – TO BE INCLUDED**

## APPENDIX D

### RADIO BROADCASTING EQUIPMENT TO DISSEMINATE AUGMENTATION DOMESTICALLY

For domestic radio broadcasting trials, the FAA uses **Radio Modem** in non-aeronautical VHF and UHF frequency bands. These are some characteristics of the radios recommended:

- **Pacific Crest RFM96**  
150-173 Mhz frequency band  
35 Watts power  
150-9600bits/seg configurable modem  
Antena ¼ de Onda “Rubber Duck”
- **FreeWave Dgr-115**  
902-928Mhz frequency band in Spread Spectrum modulation,  
1 Watt power  
1200-115Kbauds modem  
3 inch whip antenna
- **GLB Electronics Incs**  
450-470Mhz frequency band  
4Watts power  
300, 600, 1200, 2400, 4800, 9600, 19200 modem

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