

Guidelines for the installation of SIRGAS-CON stations

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March 13, 2017: Update of some Internet links.

March 12, 2013: Update of some Internet links.

September 8, 2010: The new SIRGAS FTP server is included.

September 9, 2008: Document is aligned with the guidelines contained in "Procedure for becoming a SIRGAS-CON station"

August 30, 2007: 2.b is included in the 1.c item. Numerals 1.g, 2.e, 2.f and 3.3.d are added.

August 29, 2007: Items 5.a, 5.b, 5.c, 5.e, and 5.i are included in item 4. The other items in section 5 are deleted. Section 6 is now Section 5.

This document is based on many related documents, which are listed under "References". The collaboration of the SIRGAS colleagues to improve this document is highly appreciated, especially the contribution of Tomás Marino from Costa Rica and Melvin Hoyer from Venezuela, who made the main compilation and adaptation to the SIRGAS characteristics.

Please send your comments, questions, or suggestions to Víctor Cioce, president of the SIRGAS-WGI: Reference System (vcioce@fing.luz.edu.ve)

The present document describes the requirements and recommendations for establishing and operating GNSS stations within the SIRGAS Continuously Operating Network (SIRGAS-CON). The SIRGAS-CON network is supported by the collaboration and common efforts of more than 50 governmental, academic, and scientific institutions. Although participation in the SIRGAS-CON network is voluntary, the included stations and the corresponding operator agencies must agree to follow specific standards and conventions, which guarantee the operability and quality of the SIRGAS-CON network. These guidelines correspond to the **basic (minimal) requirements** and have to be complemented with the document "*Procedure for becoming a SIRGAS-CON station*".

1. Sites

Station administrators or operators are requested to select new sites, which meet most of the following features, and make efforts to satisfy these characteristics at existing sites:

- a. The site location should be on a stable regional crustal block. Active faults or other sources of deformation, subsidence, etc. should be avoided;
- b. The site should be located on stable material, preferably rock basement. Soil that might slump, slide, heave, or vary in elevation should be avoided;
- c. The horizon around the station must be free of obstacles above 5 degrees elevation. Obstructions should be minimal above 5 degrees elevation, but satellite visibility at lower elevations is desired whenever possible;



- d. The selected site shall not be affected by changes in the environment surrounding the stations, e.g. sites with future tree or shrub growth, building constructions, rooftop additions, antenna masts, parking lots, etc. should be avoided;
- e. The site location should not have excessive radio frequency interference and excessive reflective surfaces (lakes, fences, walls, etc.) and other sources for signal multipath;
- f. It should not have excessive natural or man-made surface vibrations from ocean waves or heavy vehicular traffic;
- g. If the station is installed on a building roof, the building should have been constructed at least 5 years previously, to guarantee that all primary settling of the building has occurred. It should not have visible cracks on the walls. The monument should be directly attached to a main load-bearing wall.

2. Monumentation

The station should satisfy standard requirements for a first order geodetic monument with respect to robustness, stability, permanence, long-term maintenance, documentation, and access. For geodetic site monumentation, please see:

<http://kb.igs.org/hc/en-us/articles/202011433>,
http://www.hartrao.ac.za/geodesy/SITE_MON.HTM,
<http://kb.unavco.org/kb/article.php?id=55>

- a. The station description should be completely documented in the corresponding site log file. See item 4.c.;
- b. Signal reception quality has to be guaranteed, i.e. interference of external signal sources like multipath, radars, TV, mobile telephones, etc. must be minimal;
- c. The antenna reference point should be mounted vertically above the marker (i.e., horizontal eccentricities ideally are zero);
- d. It is highly recommended to establish some (two or three) control points (excenters) surrounding the main station (~200 m) to observe possible local movements or deformations;
- e. The materials used in the monumentation, such as concrete, metallic masts, tensile cables, accessories, paintings, etc. should be resistant to the environmental effects in the long term and not to be vulnerable to oxidation, erosion, etc.;
- f. It is recommended to complement the monumentation with protective elements against flash of lightning. The lightning conductors should be preferably of ionizing type, including arrestors in the wiring between the antenna and the receiver. The GNSS antenna should be located within the protective cone of the lightning conductor.

3. Equipment

The GNSS equipment shall not be moved or changed unless it is really necessary, for instance by equipment damages, replacement of obsolete equipment, firmware updates, etc. It is also highly recommended to protect the equipment against power failures and flash of lightning.



The GNSS equipment can be installed together with other precise instrumentation like seismometers, gravimeters, tide gauges, meteorological sensors, etc.

3.1 Receiver

- a. The GNSS receiver must be included in the IGS (International GNSS Service) file ftp://igs.org/pub/station/general/rcvr_ant.tab;
- b. It has to track both GPS codes and phases on L1 and L2 under non-AS (Anti Spoofing) as well as AS conditions. Required observables are L1, L2, P2, and at least one of C1 or P1;
- c. It must be capable to record signal from at least 10 satellites, simultaneously;
- d. It shall track at least with 30 seconds sampling rate. 1, 10 or 15 seconds are also accepted;
- e. It should be set to record data down to a cut off of 5 degrees or less, desirable 0 degrees;
- f. It should synchronize the real instant of observation with true GPS time within ± 1 millisecond of the full second epoch;
- g. It has to be able to track all satellites regardless of health status and to be programmed so that no smoothing is applied to the observables;
- h. The site operators must keep all receiver firmware updated, and inform SIRGAS as soon as updates or equipment changes occur using the SIRGAS Mail Explorer (<http://sirmail.dgfi.tum.de/>). Please specify the four-character site abbreviation in the subject line;
- i. It is strongly recommended that equipment be upgraded or replaced as technology changes, e.g. new GPS signals added. Equipment changes should however be minimized as they can generate modifications in the station position;
- j. If data quality decreases and the site operator is unable to solve or minimize the problem, SIRGAS may decide to remove the site from the SIRGAS-CON network.

3.2 Antenna

- a. The GNSS antenna must be included in the IGS file ftp://igs.org/pub/station/general/rcvr_ant.tab;
- b. It must also be described in the IGS file <ftp://igs.org/pub/station/general/antenna.gra> and the absolute correction for its phase centre variations shall be available at the IGS site ftp://igs.org/pub/station/general/pcv_archive/;
- c. It has to be horizontal (levelled) and oriented to the North using the North reference mark;
- d. The antenna shall be rigidly attached, such that there is not more than 0,1 mm motion with respect to the antenna mounting point (for monumentation see item 2);
- e. The eccentricities (east, north, height) from the primary marker to the antenna reference point, defined in <ftp://igs.org/pub/station/general/antenna.gra>, must be surveyed and reported in the site logs and RINEX headers at a 1 mm – level accuracy;
- f. Choke ring antennae are preferred;



- g. If no antenna radome is used, it is recommended to clean the antenna, without removing it, at least once a year.

3.3 Radomes

- a. It is desirable to avoid using radomes unless required operationally, for instance due to weather conditions, antenna security, wildlife concerns, etc.;
- b. If a radome is used, it must be included in the IGS file ftp://igs.org/pub/station/general/rcvr_ant.tab;
- c. If a radome is used, the calibration values for the phase centre variations of the antenna+radome pair must be included in the IGS site ftp://igs.org/pub/station/general/pcv_archive/;
- d. If a radome is used, it should be attached to the antenna with plastic screws or nonconductive materials.

4. Operation

- a. Stations must permanently and continuously operate;
- b. Stations must be registered at the IERS (International Earth Rotation and Reference Systems Service) and be identified by a four-character code and a DOMES number given by the IERS. The four-character abbreviation could be appointed by the station administrator. Nevertheless, its availability shall be checked at <ftp://igs-rf.ign.fr/pub/DOMES/codomes.snx> to prevent duplications.

The DOMES number request must be submitted at http://itrf.ensg.ign.fr/domes_request.php. Here, you have to use the standard names given by the IGS to your antenna, radome, and receiver types. The conversion table between the names defined by the manufacturers and those assigned by the IGS is available at ftp://igs.org/pub/station/general/rcvr_ant.tab;

- c. For each station, a site log must be prepared. The format of the site log is identical to the site log format used within the IGS. This site log is uniquely linked to the station and describes its history (e.g. receiver and antenna changes). Therefore, the site log is of equal importance as the GNSS data collected at a site.

Whenever there is a change to the site information as documented in the station log, it must be updated.

A blank site log form is available at <http://www.igs.org/network/information>. It must be completed including the DOMES number given by the IERS and following the instructions given at ftp://www.igs.org/pub/station/general/sitelog_instr.txt.

Examples of site logs are accessible at <ftp://ftp.sirgas.org/pub/gps/DGF/station/log>;

- d. Station infrastructure should include ample, reliable power and communications (preferably Internet) to enable reliable data transfer. If it is necessary, additional site security measures must be taken into account to guarantee the required performance;
- e. First order levelling connection, together with gravity observations, to the national precision vertical network is desirable;



- f. A station operator interested on including a permanent station into the SIRGAS-CON network shall follow the guidelines included in “***Procedure for becoming a SIRGAS-CON station***”;
- g. A SIRGAS-CON station may be classified as inactive when:
 - it is excluded of the weekly processing due to bad data quality or site log file inconsistencies;
 - it is decommissioned due to destruction or strongly position changes generated by equipment updates or replacement, seismic events, etc.;
 - its observations were not available for the latest processed week and the operating agency did not report any problem through the SIRGAS Mail Exploder.
- h. Inactive stations can recover the operational status when they satisfy the requirements detailed in the items 1, 2, 3, and 4 of the present document.

References

IGS Site Guidelines <http://kb.igs.org/hc/en-us/articles/202011433>

UNAVCO: Permanent GNSS/GPS Station Planning: Technology, Equipment, Costs
<http://kb.unavco.org/kb/article.php?id=55>

Physical Site Specifications: Geodetic Site Monumentation (W.L. Combrinck and M. Schmidt) http://www.hartrao.ac.za/geodesy/SITE_MON.HTM

NOAA/NGS Guidelines for establishing and operating CORS
http://www.ngs.noaa.gov/PUBS_LIB/CORS_guidelines.pdf

Procedure for becoming an EPN station
http://www.epncb.oma.be/organisation/guidelines/procedure_becoming_station.pdf

Guidelines for EPN stations and operational centres
http://www.epncb.oma.be/organisation/guidelines/guidelines_station_operationalcentre.pdf