Guidelines for APREF Stations Operators

VERSION 1.0

Geoscience Australia, GPO Box 378, Canberra ACT 2601

Contents

Introduction

This document provides a set of requirements and recommendations that should be followed by station operators who would like data from a CORS to be added to the Asia-Pacific Reference Frame (APREF) GNSS network. While a strict set of rules is consistent with the voluntary nature of the project, it is asked that all participating agencies follow a certain set of standards and conventions to ensure the quality of the project and its outputs.

This document aims to assist station operators in managing their sites and data to ensure full compatibility with the APREF data and analysis centres. For the remainder of this document the station operator is defined as the person or agency responsible for interfacing with the CORS, checking the data quality and seeing that it is received by the APREF data centre(s).

Further details on the APREF project can be found at:

http://www.ga.gov.au/earth-mointoring/geodesy/asia-pacific-reference-frame.html

Abbreviations

APREF	Asia-Pacific Reference Frame
APREF CB	Asia-Pacific Reference Frame Central Bureau (currently Geoscience Australia)
CORS	Continuously Operating Reference Stations
GNSS	Global Navigation Satellite Systems
IERS	International Earth Rotation Service
IGS	International GNSS Service

Procedures for Becoming an APREF Station

APREF encourages participation from organisations active in the Asia-Pacific region who are prepared to, on an on-going basis (at least two years) provide access to GNSS data from CORS located in the Asia-Pacific region.

For a CORS to be included into the APREF network the following steps must be undertaken:

1. Station operators should ensure that their site meets or exceeds all of the criteria set out in sections A – E of this document. If a new site is to be built specifically for the APREF project it is encouraged that the APREF CB be contacted for advice about location and equipment to be used.

2. Send an email to geodesy@ga.gov.au with the subject heading "Proposed APREF CORS", in this email include:

    a. the proposed 4-character site code (see section D1),
    b. photographs of the proposed site (see section D2),
    c. a completed site log-file (see section D3).
    d. a link to some sample data from the site (see section C).

3. APREF CB will check the quality of the data submitted and the completeness of the site log-file.

4. If the above is ok, the site will be accepted into the APREF network. If there is a problem with the submission the station operator will be contacted with the recommended changes.

5. The APREF data centre(s) will coordinate with the station operator to establish data flow and begin archiving the data.

6. APREF CB will inform analysis centres of the site and start analysis of the data.

7. APREF CB will make the following products available online (unless specific agreements exist with the station operator):

    e. Daily (24-hour) RINEX observation data,
    f. station log-files,
    g. weekly coordinate estimates,
    h. time-series plots.

8. Once the site has been accepted into the APREF network, it is important that any changes to equipment or the site (including receiver firmware upgrades) be reported to the APREF CB immediately via updated station log-files.

Guidelines for APREF CORS

If possible APREF stations should meet the standards of the IGS; otherwise the following guidelines should be followed as closely as possible.

The IGS guidelines can be found at:

http://igscb.jpl.nasa.gov/netowrk/guidlines/guidelines.html

A. Monument

There is no "prefect" monument, but the station operator should ensure that the antenna is well anchored to the ground, such that the position and velocity associated with a given site represents the crustal position and velocity of the site and not jus the antenna.

An overview of CORS monumentation can be found at:

http://facility.unavco.org/kb/questions/104/UNAVCO+Resources%3A+GNSS+Station+Monumentation

Within the APREF project sites will be categorised into a three-tier hierarchy based on their stability, with tier 1 sites being the most stabile. The stability will be judged primarily on the type of monumentation used. APREF CB will use the provided site photos to judge the level of stability.

B. Equipment

Station operators are responsible for the maintenance and up-keep of their equipment. It is recommended that the receiver firmware be kept up-to-date and that the equipment be upgraded or replaced as technology changes. However, changes in equipment should be kept to a minimum, as even the most minor change can cause discontinuities in the coordinate time-series.

It is important that ALL changes to the site are documented in the station log-files and communicated to APREF CB.

B1. Antenna

The antenna must be:

- Known to IGS and the standard name must appear in ftp://igscb.jpl.nasa.gov/pub/station/general/rcvr_ant.tab.
- Represented accurately in the IGS phase centre variation file ftp://igscb.jpl.nasa.gov/pub/station/general/igs08.atx.
- Levelled and orientated to true north using the antenna north reference mark.
- Rigidly attached to the monument.
- Have known north, east and up eccentricities.

Additionally (if possible) the antenna should:

- Be capable of tracking L5.
- Be capable of tracking GLONASS and other navigation satellite constellations.
- Have an absolute calibration.
- Be inspected regularly, if the antenna is cleared of snow or debris this should be reported in the station log-files under section 9.

B2. Radomes

- It is recommended that radomes only be used if there is an operational requirement to do so (such as weather or wildlife concerns).

- Should a radome be used, the antenna + radome combination must be in the IGS phase centre variation file ftp://igscb.jpl.nasa.gov/pub/station/general/igs08.atx.

B3. Receivers

The receiver must be capable of:

- Tracking L1 and L2,
- Providing L1 C/A-code or P-code pseudo range and both L1 and L2 full wavelength carrier phase,
- Tracking at least 10 satellites above a 0 degree horizon.

The receiver must be programmed to:

- Record all satellited in view, regardless of health.,
- Track with an elevation cut-off angle of 0 degrees,
- Record at a sample rate of 30 seconds,
- Not smooth the data.

Additionally (if possible) the receiver should be:

- Set to track L2C and L5 (although L2C should not be tracked in preference to L2P).
- Capable of tracking GLONASS and/or other navigation satellite constellations.

C. Data Flow and Archiving

C1. Data Format

GNSS data must be made available to APREF data centre(s) in the following formats:

- GNSS data converted to RINEX version 2.11 (contact APREF CB for other formats). http://igscb.jpl.nasa.gov/igscb/data/format/rinex211.txt
- Daily observations files with data collected between 00:00:00 and 23:59:59 GPS time.
- All data must be sampled at 30 second epochs.

It is desirable that the data be:

- Hatanaka compressed RINEX files that have been gzipped, Unix compressed or zipped.
- Navigation and Meteorological files will also be accepted.

C2. Data Transfer

All data transfer between the station operator and the APREF data centre(s) must be done over the internet. The data centre(s) should either receive or be able to retrieve the daily (24-hour) RINEX products within 2 hours of the end of the GPS day.

All files whether received or retrieved must use the following naming conventions (all in lowercase), which follows the standard RINEX conventions.

ssssdddh.yyt[.c]

Where,

ssss	is the 4-character site id (lowercase).
ddd	is the day of the year.
h	is an alphanumeric character indicating the hour.
yy	is the two digit year.
t	is the type of file.

- o is a RINEX observation file.
- d is a Hatanaka compressed RINEX observation file.
- n is a RINEX navigation file.
- g is a RINEX glonass navigation file.
- m is a RINEX meteorological file.

c is the type of compression (optional).

- gz GNU zip (gzip).
- Z UNIX compression (compress).
- zip Zip

The preferred method of transfer is for the data to be uploaded or "pushed" to the data centre(s) via FTP. In this case the data must be submitted to the following directory at the primary data centre:

/incoming/ssss/ssssdddh.yyt[c]

Once the APREF data centre picks up the data this file will be removed from then incoming directory, hence it is important that the software used by the station operator to "push" the data file does not attempt to resend files that have already been sent to this directory.

If the station operator is responsible for a significant number of APREF sites or cannot for some reason access the data centre's FTP server, arrangements can be made for the data to be retrieved form the station operators FTP or web server. If this method is used the station operators directory structure must mimic the following:

/base-directory/yyyy/ddd/ssss/ssssdddh.yyt[.c]

Where,

base-directory	can be any directory on the station operators FTP or web server.

C3. Data Archiving

One of the goals of the APREF project is to make a publicly accessible GNSS data archive for the Asia-Pacific region. Unless specified by the station operator the submitted RINEX products for each site will be made available daily on the APREF anonymous FTP server. The following directory structure is used:

ftp.ga.gov.au

/geodesy-outgoing/gnss/data/yyyy/yyddd/ssssdddh.yyt.c

The standard RINEX naming conventions are used. All files in the data archive are Hatanaka compressed RINEX observation files that have been UNIX compressed.

D. Station Metadata

All changes to the site must be communicated to the APREF CB either via an updated station log-file or an advisory email as soon as possible after a change has been made.

D1. Site Identification

Each CORS in the APREF network is identified using a unique 4-character site code. This code should try to represent the location of the site for easy recognition.

Eg. The CORS at Alice Springs is identified by the 4-character code ALIC.

To ensure 4-character site code is unique please contact the APREF CB who will help allocate a unique code. You can also use the tool provided by the SCRIPPS Orbit and Permanent Array Centre (SOPAC). A valid result from this check does not guarantee the site code is available for the APREF network.

http://www.sopac.ucsd.edu/scripts/checkSiteID.cgi

Each site is also required to have a unique 8-character identifier. It is recommended that all sites that meet the specifications of Tier 1 or Tier 2, apply for an International Earth Rotations Service (IERS) DOMES numbers.

Information and application forms for IERS DOMES numbers can be found at:

http://www.itrf.ensg.ign.fr/dome_desc.php

For sites that are of Tier 3 quality (or lower) we have developed a unique 8-character APREF numbering systems that is similar to that IERS DOMES system.

Eg. AUM00001

Where,

The first two characters represent the country code (eg. AU for Australia).
The next character represents the reference point (eg. M = Monument)

The next 5 characters represent the site number.

If the site does not have an IERS DOMES number an APREF number will be allocated by APREF CB once the site has been accepted.

D2. Site Photographs

A set of sharply focus digitally photographs are required to evaluate and document the site. When taking photographs the purpose is to give a clear view of the space around the site, the equipment being used and how it is assembled. Photographs must use the filename described below (where ssss is the site name). The preferred format for photograph is JPEG (please also ensure photos of an appropriate resolution).

The following photographs are required:

1. Four orientated photographs taken at the height of the antenna. The antenna should be included in all of the photographs, but should not block the ability to view what lies beyond the antenna (stand about 3 – 5 metres away from the antenna).

   ssss_ant_000.jpg (facing north)
   ssss_ant_090.jpg (facing east)
   ssss_ant_180.jpg (facing south)
   ssss_ant_270,jpg (facing west)

The following photographs are desirable (but not essential):

2. Close up photographs of the primary equipment (antenna and receiver) showing their models and serial numbers.

   ssss_ant_sn.jpg
   ssss_rec_sn.jpg

3. If the monument is located on a building please provide a photograph of the building, showing clearly how and where the antenna is located. Also provide a photograph showing the roof surface and the antenna

   ssss_ant_bldg.jpg
   ssss_ant_roof.jpg

(see Appendix A for example photos)

D3. Station Log-File

The station log-file used for the APREF project follows the format specified by the IGS. This file contains all the historical information about the site and details the equipment and monument used. The station log-file is of equal importance as the GNSS data collected. An example log-file is displayed in Appendix B.

A blank station log-file can be downloaded from:

http://igscb.jpl.nasa.gov/igscb/station/general/blank.log

E. Data Quality and Operations

To ensure data quality within the APREF network all incoming RINEX files will undergo basic quality checks before being allowed into the data archive. The first round of quality checks compares the incoming files RINEX header with the provided station log-file. If a discrepancy occurs the data is blocked from the archive until the problem is resolved. If the problem is not resolved the station operator will be notified.

The minimum information required in the RINEX header is:

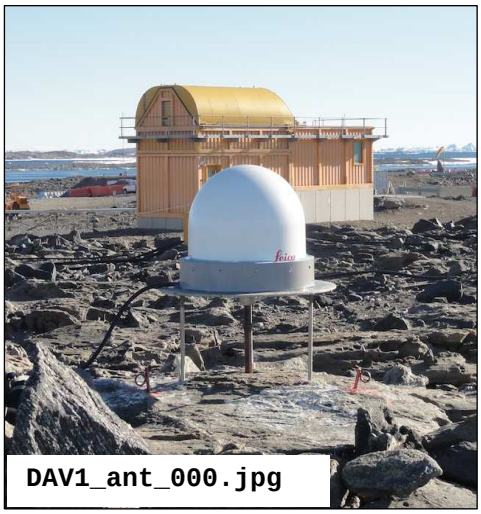
Marker Name
Marker Number
Observer / Agency
REC # / TYPE / VERS
ANT # / TYPE / VERS
Approx Position
Antenna: Delta H / E / N

Once the data has been saved to the primary archive further verifications are made on the quality of the data using the TEQC program (http://facility.unavco.org/software/teqc/teqc.html). The results of these checks are available for viewing at:

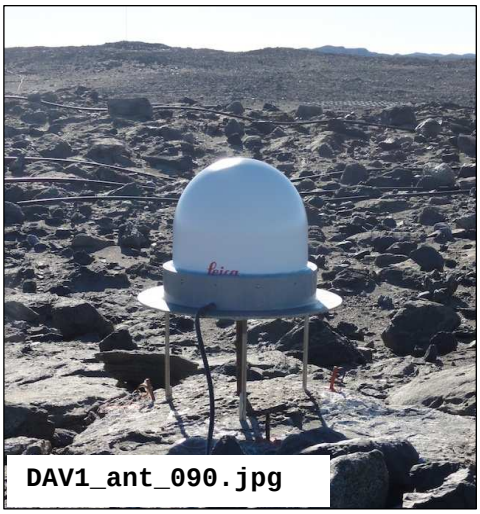
http://192.104.43.25/status/ALLDaily.html

It is highly recommended that station operators undertake some form of quality checking before the data is submitted to the APREF data centre(s).

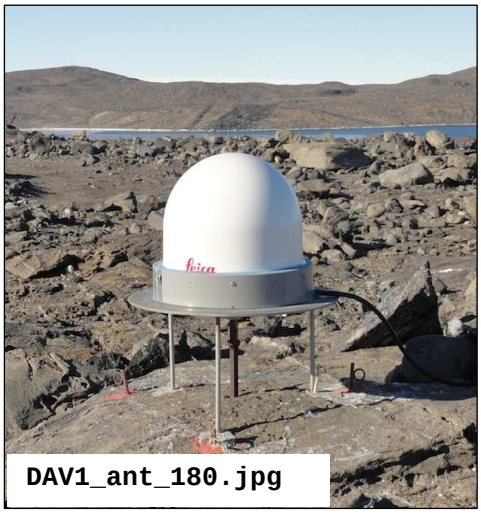
Appendix A – Site Photographs



DAV1_ant_000.jpg

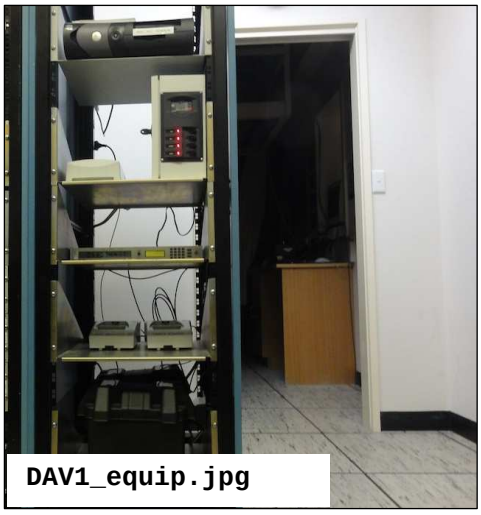


DAV1_ant_090.jpg



DAV1_ant_180.jpg

DAV1_ant_270.jpg



DAV1_equip.jpg

DAV1_met.jpg

Appendix B – Example Log-File

```
KAT1 Site Information Form (site log)

0.   Form

     Prepared by (full name)  : Ryan Ruddick
     Date Prepared            : 2011-07-25
     Report Type              : UPDATE
     If Update:
      Previous Site Log       : kat1_20110606.log
      Modified/Added Sections : 6.1,11,12

1.   Site Identification of the GNSS Monument

     Site Name                : Katherine
     Four Character ID        : KAT1
     Monument Inscription     :
     IERS DOMES Number        : 59968M001
     CDP Number               :
     Monument Description     : PILLAR
       Height of the Monument : 1.5 m
       Monument Foundation    : CONCRETE BLOCK
       Foundation Depth       : 2.0 m
     Marker Description       : STAINLESS STEEL PLATE / THREADED SPIGOT
     Date Installed           : 2010-03-15T00:00Z
     Geologic Characteristic  : BEDROCK / LIMESTONE
       Bedrock Type           : SEDIMENTARY
       Bedrock Condition      : KARST
       Fracture Spacing       :
       Fault zones nearby     : NO
         Distance/activity    :
     Additional Information   :

2.   Site Location Information

     City or Town             : Katherine
     State or Province        : Northern Territory
     Country                  : Australia
     Tectonic Plate           : Australian
     Approximate Position (ITRF)
       X coordinate (m)       : -4147413.5240
       Y coordinate (m)       :  4581462.7810
       Z coordinate (m)       : -1573359.6730
       Latitude (N is +)      : -142233.6335
       Longitude (E is +)     : +1320911.7652
       Elevation (m,ellips.)  : +0184.4760
     Additional Information   :

3.   GNSS Receiver Information

3.1  Receiver Type            : LEICA GRX1200+GNSS
     Satellite System         : GPS+GLONASS
     Serial Number            : 495619
     Firmware Version         : 7.53
     Elevation Cutoff Setting : 0 deg
     Date Installed           : 2010-03-13T00:00Z
     Date Removed             : 2010-04-22T00:00Z
     Temperature Stabiliz.    : none
     Additional Information   :

3.2  Receiver Type            : LEICA GRX1200+GNSS
     Satellite System         : GPS+GLONASS
     Serial Number            : 495619
     Firmware Version         : 7.80
     Elevation Cutoff Setting : 0 deg
     Date Installed           : 2010-04-22T00:00Z
     Date Removed             : 2011-03-10T23:00Z
     Temperature Stabiliz.    : none
     Additional Information   :
```

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3.3  Receiver Type            : LEICA GRX1200+GNSS
     Satellite System         : GPS+GLONASS
     Serial Number            : 495619
     Firmware Version         : 8.01/4.004
     Elevation Cutoff Setting : 0 deg
     Date Installed           : 2011-03-10T23:00Z
     Date Removed             : 2011-06-06T00:00Z
     Temperature Stabiliz.    : none
     Additional Information   :

3.4  Receiver Type            : LEICA GRX1200+GNSS
     Satellite System         : GPS+GLONASS
     Serial Number            : 495619
     Firmware Version         : 8.20/4.007
     Elevation Cutoff Setting : 0 deg
     Date Installed           : 2011-06-06T00:00Z
     Date Removed             :
     Temperature Stabiliz.    : none
     Additional Information   :

3.x  Receiver Type            : (A20, from rcvr_ant.tab; see instructions)
     Satellite System         : (GPS/GLONASS/GPS+GLONASS)
     Serial Number            : (A20, but note the first A5 is used in SINEX)
     Firmware Version         : (A11)
     Elevation Cutoff Setting : (deg)
     Date Installed           : (CCYY-MM-DDThh:mmZ)
     Date Removed             : (CCYY-MM-DDThh:mmZ)
     Temperature Stabiliz.    : (none or tolerance in degrees C)
     Additional Information   : (multiple lines)


4.   GNSS Antenna Information

4.1  Antenna Type             : LEIAR25.R3      LEIT
     Serial Number            : 09310015
     Antenna Reference Point  : BPA
     Marker->ARP Up Ecc. (m)  : 000.0000 m
     Marker->ARP North Ecc(m) : 000.0000 m
     Marker->ARP East Ecc(m)  : 000.0000 m
     Alignment from True N    : 0 deg
     Antenna Radome Type      : LEIT
     Radome Serial Number     :
     Antenna Cable Type       : RG58 / LMR400 / RG58
     Antenna Cable Length     : 0.3 m / 100 m / 0.3 m
     Date Installed           : 2010-03-13T00:00Z
     Date Removed             :
     Additional Information   : Huber + Suhner gas lightning arrestor (3402.17.0044)
                              : at receiver end between RG58 and LMR400.

4.x  Antenna Type             : (A20, from rcvr_ant.tab; see instructions)
     Serial Number            : (A*, but note the first A5 is used in SINEX)
     Antenna Reference Point  : (BPA/BCR/XXX from "antenna.gra"; see instr.)
     Marker->ARP Up Ecc. (m)  : (F8.4)
     Marker->ARP North Ecc(m) : (F8.4)
     Marker->ARP East Ecc(m)  : (F8.4)
     Alignment from True N    : (deg; + is clockwise/east)
     Antenna Radome Type      : (A4 from rcvr_ant.tab; see instructions)
     Radome Serial Number     :
     Antenna Cable Type       : (vendor & type number)
     Antenna Cable Length     : (m)
     Date Installed           : (CCYY-MM-DDThh:mmZ)
     Date Removed             : (CCYY-MM-DDThh:mmZ)
     Additional Information   : (multiple lines)

5.   Surveyed Local Ties

5.x  Tied Marker Name         :
     Tied Marker Usage        : (SLR/VLBI/LOCAL CONTROL/FOOTPRINT/etc)
     Tied Marker CDP Number   : (A4)
     Tied Marker DOMES Number : (A9)
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : (m)
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       dy (m)                : (m)
       dz (m)                : (m)
     Accuracy (mm)           : (mm)
     Survey method           : (GPS CAMPAIGN/TRILATERATION/TRIANGULATION/etc)
     Date Measured           : (CCYY-MM-DDThh:mmZ)
     Additional Information  : (multiple lines)

6.   Frequency Standard

6.1  Standard Type           : INTERNAL
       Input Frequency       :
       Effective Dates       : 2010-03-15/2011-07-25
       Notes                 :

6.x  Standard Type           : H-MASER
       Input Frequency       : 10 Mhz
       Effective Dates       : 2011-07-25/
       Notes                 : Vremya-ch model VCH-1005A

7.   Collocation Information

7.1  Instrumentation Type    : GPS+GLONASS
       Status                : PERMANENT
       Effective Dates       : 2010-03-15
       Notes                 : KAT2

7.2  Instrumentation Type    : VLBI
       Status                : PERMANENT
       Effective Dates       : 2010-03-15
       Notes                 : 12m Patriot Radio Telescope

7.x  Instrumentation Type    : (GPS/GLONASS/DORIS/PRARE/SLR/VLBI/TIME/etc)
       Status                : (PERMANENT/MOBILE)
       Effective Dates       : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                 : (multiple lines)

8.   Meteorological Instrumentation

8.1.1  Humidity Sensor Model  : PAROSCIENTIFIC MET4
       Manufacturer          : PAROSCIENTIFIC
       Serial Number         : DQ114877
       Data Sampling Interval : 30 sec
       Accuracy (% rel h)    : 2.0
       Aspiration            : UNASPIRATED
       Height Diff to Ant    : -0.7600 m
       Calibration date      : 2010-03-15
       Effective Dates       : 2010-03-15/CCYY-MM-DD
       Notes                 :

8.1.x Humidity Sensor Model  :
       Manufacturer          :
       Serial Number         :
       Data Sampling Interval : (sec)
       Accuracy (% rel h)    : (% rel h)
       Aspiration            : (UNASPIRATED/NATURAL/FAN/etc)
       Height Diff to Ant    : (m)
       Calibration date      : (CCYY-MM-DD)
       Effective Dates       : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                 : (multiple lines)

8.2.1 Pressure Sensor Model  : PAROSCIENTIFIC MET4
       Manufacturer          : PAROSCIENTIFIC
       Serial Number         : DQ114877
       Data Sampling Interval : 30 sec
       Accuracy              : 0.08
       Height Diff to Ant    : -0.7600 m
       Calibration date      : 2010-03-15
       Effective Dates       : 2010-03-15/CCYY-MM-DD
       Notes                 :

8.2.x  Pressure Sensor Model  :
       Manufacturer          :
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```
       Serial Number          :
       Data Sampling Interval : (sec)
       Accuracy               : (hPa)
       Height Diff to Ant     : (m)
       Calibration date       : (CCYY-MM-DD)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                  : (multiple lines)

8.3.1 Temp. Sensor Model      : PAROSCIENTIFIC MET4
       Manufacturer           : PAROSCIENTIFIC
       Serial Number          : DQ114877
       Data Sampling Interval : 30 sec
       Accuracy               : 0.5
       Aspiration             : UNASPIRATED
       Height Diff to Ant     : -0.7600 m
       Calibration date       : 2010-03-15
       Effective Dates        : 2010-03-15/CCYY-MM-DD
       Notes                  :

8.3.x  Temp. Sensor Model     :
       Manufacturer           :
       Serial Number          :
       Data Sampling Interval : (sec)
       Accuracy               : (hPa)
       Aspiration             : (UNASPIRATED/NATURAL/FAN/etc)
       Height Diff to Ant     : (m)
       Calibration date       : (CCYY-MM-DD)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                  : (multiple lines)

8.4.x  Water Vapor Radiometer :
       Manufacturer           :
       Serial Number          :
       Distance to Antenna    : (m)
       Height Diff to Ant     : (m)
       Calibration date       : (CCYY-MM-DD)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                  : (multiple lines)

8.5.x  Other Instrumentation  :

9.  Local Ongoing Conditions Possibly Affecting Computed Position

9.1.x Radio Interferences     : (TV/CELL PHONE ANTENNA/RADAR/etc)
       Observed Degradations  : (SN RATIO/DATA GAPS/etc)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Additional Information : (multiple lines)

9.2.x Multipath Sources       : (METAL ROOF/DOME/VLBI ANTENNA/etc)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Additional Information : (multiple lines)

9.3.x Signal Obstructions     : (TREES/BUILDLINGS/etc)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Additional Information : (multiple lines)

10.  Local Episodic Effects Possibly Affecting Data Quality

10.x Date                     : (CCYY-MM-DD/CCYY-MM-DD)
     Event                    : (TREE CLEARING/CONSTRUCTION/etc)

11.  On-Site, Point of Contact Agency Information

     Agency                   : Geoscience Australia
     Preferred Abbreviation   : GA
     Mailing Address          : National Geospatial Reference Frames Project
                              : Geoscience Australia
                              : GPO Box 378
                              : Canberra  ACT  2609
                              : Australia
     Primary Contact
       Contact Name           : Ryan Ruddick
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       Telephone (primary)    : +61 2 6249 9426
       Telephone (secondary)  : +61 2 6249 9111
       Fax                    : +61 2 6249 9929
       E-mail                 : ryan.ruddick@ga.gov.au
     Secondary Contact
       Contact Name           : Amy Peterson
       Telephone (primary)    : +61 8 8995 5361
       Telephone (secondary)  :
       Fax                    :
       E-mail                 : amy.peterson@nt.gov.au
     Additional Information   :

12.  Responsible Agency (if different from 11.)

     Agency                   : Geoscience Australia
     Preferred Abbreviation   : GA
     Mailing Address          : National Geospatial Reference Frames Project
                              : Geoscience Australia
                              : GPO Box 378
                              : Canberra  ACT  2609
                              : Australia
     Primary Contact
       Contact Name           : Ryan Ruddick
       Telephone (primary)    : +61 2 6249 9426
       Telephone (secondary)  : +61 2 6249 9111
       Fax                    : +61 2 6249 9929
       E-mail                 : ryan.ruddick@ga.gov.au
     Secondary Contact
       Contact Name           : Amy Peterson
       Telephone (primary)    : +61 8 8995 5361
       Telephone (secondary)  :
       Fax                    :
       E-mail                 : amy.peterson@nt.gov.au
     Additional Information   :

13.  More Information

     Primary Data Center      : GA
     Secondary Data Center    :
     URL for More Information : ftp.ga.gov.au
     Hardcopy on File
       Site Map               : Y
       Site Diagram           : Y
       Horizon Mask           :
       Monument Description   : Y
       Site Pictures          : Y
     Additional Information   :
     Antenna Graphics with Dimensions


LEIAR25.R3

                         +-------+                          <--  0.1995
                        /         \
                  +---+-------------+---+                   <--  0.1606  TCR
                  |                     |
              |---------------------------|
          |-----------------------------------|
       |--------------------------------------|
     +----------------------------------------------+
     |                                              |
     |                                              |
   +-+----------------------------------------------+-+
   +-----------------+-------------+-----------------+     <--  0.0320  BCR
                     |             |
                     |             |
                     +------x------+                       <--  0.0000  BPA=ARP

   <--                   0.3802                    -->
```