

Report to the 19th meeting of the CCTF from the National Metrology Institute of South Africa (NMISA)

September 2012

1. UTC(ZA)

The NMISA operates four commercial thermal beam caesium atomic clocks. Two of these clocks are high-performance tubes, with the remaining two being long-life tubes. All of the clocks are free-running and not steered or corrected. UTC(ZA) is currently based on a single clock.

NMISA maintains UTC(ZA) to within 5 microseconds of UTC by means of a time step when required. The last time step was on 19 April 2011 (MJD 55670). Since then, the monthly average frequency error of UTC(ZA) was between $1,1 \cdot 10^{-13}$ and $0,8 \cdot 10^{-13}$ (the expected error, due to gravitational shift, is $1,4 \cdot 10^{-13}$.)

It was realised that all of the clocks in the institute will reach the end of guaranteed life at about the same time. It was decided to pre-emptively perform a tube replacement on some of the clocks, preventing a possible scenario where all of the clocks fail at the same time.

TF0001 was switched off and returned to the manufacturer for a tube replacement on 30 August 2011. It was returned to NMISA on 24 January 2012. Data submission started again on 28 January 2012. The clock received a zero TAI weight for March to June and its first non-zero weight in July 2012.

TF0005, a high-performance clock, became unstable in March 2012 after only 5½ years of operation. The clock was returned to the manufacturer for a repair and a possible tube replacement. (It is still with the manufacturer.)

TF0006, a high-performance clock, currently has a very high ion pump current. This is one of the signs of end-of-life, but the clock is still operating as expected.

2. Time transfer link

NMISA used to rely on a dual system single frequency GPS and GLONASS timing receiver for its time transfer link. This system became unstable during December 2007. A decision was made to purchase a new receiver, a Septentrio PolaRx3TR geodetic receiver with multi-frequency GPS and GLONASS capability. This new receiver was received in November 2009 and became the transfer link in April 2010. Currently, on data in the CGGTTS format is submitted to the BIPM. The institute aims to submit RINEX data within the next few months.

3. Time dissemination services

NMISA runs a Network Time Protocol (NTP) server to distribute time via the Internet. The server gets its time code from the main GNSS receiver and uses the 1 pulse per second from the master clock for synchronisation, but no claim regarding accuracy or traceability is made for this service.

NMISA publishes a monthly bulletin for Time & Frequency users requiring a higher accuracy. In this bulletin, the difference between UTC(ZA) and GPS time, reduced to a single point per day, is published. The bulletin also contains the average frequency of UTC(ZA) for the previous month.

4. Research activities

Research is continuing on designing and implementing an optical frequency standard using a two-photon transition of the Rubidium atom. The research aims to provide a standard that can be used in the Time & Frequency, the Dimensional as well as the Fibre Optical Metrology fields while concentrating on transportability, maintainability and robustness. A number of peer-reviewed papers were published related to this as well as work related to this activity.

We are also looking into methods of steering clocks, with the eventual aim of implementing a steered secondary clocked for UTC(ZA) that will comply with the 100ns requirement of the BIPM.

5. Accreditation status

The Time & Frequency laboratory has been accredited by the South African Accreditation System (SANAS) since July 2003. (SANAS is a member of ILAC and a signatory of the ILAC MRA.) SANAS performs regular assessments of the laboratory using local technical experts. Every four to five years, a full re-assessment is conducted using an international expert. The following people have acted as international experts/assessors:

- 2002 - Dr Peter Fisk, CSIRO (now NMI Australia) – Initial assessment
- 2006 - Dr Bruce Warrington, NMI Australia
- 2010 - Dr Banerjee, NPL India

The CMCs of the laboratory have been part of the KCDB since January 2011.

6. Participation in regional metrology activities

Mr Chris Matthee from NMISA is the current chair of the Time & Frequency Working Group of Technical Committee 1 of AFRIMETS. The current focus of the working group is to help laboratories to establish some capability in the time and frequency field.

NMISA is an associate member of APMP and regularly attends the Time and Frequency Technical Committee meetings.

7. Structure of the Time & Frequency Laboratory

The Time and Frequency Laboratory is part of the Time, Frequency and Fibre Optics Section, a section of the Electricity and Magnetism Division of the NMISA. Mr Chris Mathee is the Section Head and Mrs Natasha Nel-Sakharova the Director.

Mr Mathee can be contacted at cmathee@nmisa.org for any queries.