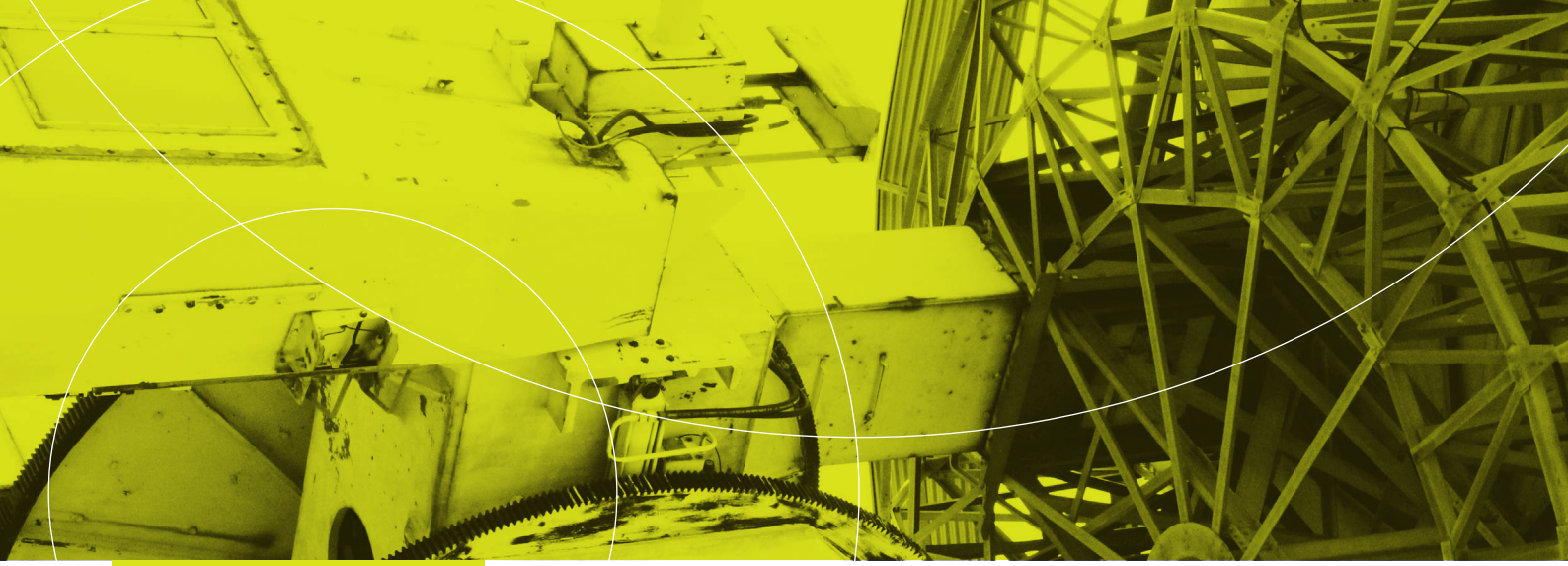
sansa
SOUTH AFRICAN NATIONAL
SPACE AGENCY

SPACE OPERATIONS



- Antenna services
- Launch support services
- TT&C services
- Antenna hosting & maintenance
- Teleport services

Introduction

The SANSA Space Operations (SO) directorate is ideally geographically positioned as a centre for Tracking, Telemetry and Command (TT&C) for geo-synchronous, polar orbiting and scientific spacecraft. The SANSA SO directorate has over 60 years of experience in the Satellite and Aerospace industry, providing TT&C support since its inception which started with NASA and JPL in 1960.

The site boasts a wide array of TT&C ground segment capabilities and establishments for many space agencies and satellite operators. The site continues to be regarded as a 'ground station of choice' globally. SANSA SO currently operates antenna systems in the S, C, X, Ku, DBS and Ka bands

SANSA SO has an exceptionally experienced and skilled team of 65 staff members, which includes technicians, engineers, project managers, as well as support and administrative services.

SANSA SO offers the following advantages:

- A favourable geographic location enabling the support of a wide range of satellite orbital slots
- Easy access for people and equipment via Johannesburg International Airport.
- Staff experienced in providing daily TT&C operations
- A commitment to long term support.
- A financially sound business.
- A capable and strong parent company that is at the leading edge of technology in Southern Africa.
- Ability to operate and maintain technologically advanced systems
- Access to other suitable sites in the Republic of South Africa.
- 24 x 7 operations, 365 days a year.
- Redundant high-speed communication infrastructure
- Reliable power distribution

Technical support
Performing all preventative and reactive maintenance activities

Operations
Conducting all TT&C operations including LEOP and emergency support

Engineering
Undertaking all new projects and systems modification projects

SANSA SO has been active in satellite tracking and ground support since the late 1950s. From 1960 to 1975, it was operated as a station of NASA's Satellite Tracking and Data Acquisition Network (STADAN).

In 1980, the functions of the French CNES tracking station near Pretoria, which had been under CSIR management since 1974, were transferred to Hartbeesthoek and integrated with those of the (then) Satellite Remote Sensing Centre. Since then the station has provided launch and orbital support for over 550 space missions within its coverage.

Since 1982, the station has performed more than 550 successful launch support and critical satellite operations and provided TT&C support on a continuous basis for polar orbiting and geostationary satellites.

In October 1996, the CSIR changed its focus from conducting pure research under Parliamentary grant funding to becoming commercially self-sustainable. As part of the CSIR, the satellite tracking station (known as the Satellite Applications Centre or SAC at the time), also had to commercialise its operations. Almost 15 years later, on 1 April 2011, SAC was incorporated into the newly established South African National Space Agency (SANSA), as its Space Operations (SO) directorate.

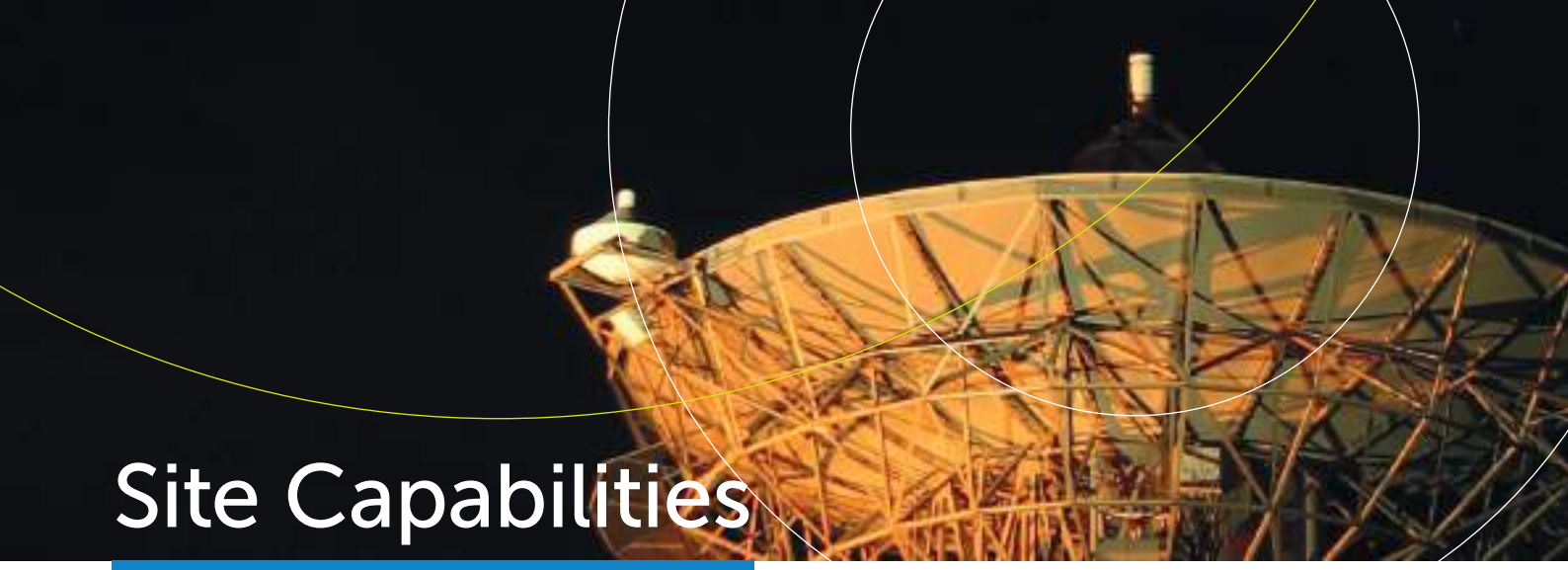
System Engineering and Project Management Capabilities

Over the years, SANSA SO has gained valuable experience in successfully implementing TT&C support projects, upgrading of facilities, interfacing existing capabilities with customer furnished equipment, setting up data communications links, and training operations teams for new support and services.

SANSA SO has the capabilities and facilities to directly support any ground segment requirements, from the establishment of an antenna facility right through to operations and maintenance of such facilities. Our Engineering unit is well equipped to implement all mandatory tasks for establishing, upgrading or modifying ground segment facilities including:

- Project Management
- System Engineering
- Architectural and Civil services
- Electrical and mechanical services
- Frequency licensing
- Import and transport of equipment
- Installation and qualification

These services are also applied internally for the modification of antenna systems to meet specific mission requirements.



Site Capabilities

This section provides an overview of the existing infrastructures and systems available at SANSA SO.

Site Description

SANSA SO is nestled in a quiet and remote area of the Magaliesburg mountain range at 1553m ASL in an area called Hartbeesthoek. The area provides an extremely good horizon mask for tracking low-orbit satellites and supporting low elevation acquisitions. The site is located approximately 60km west of Pretoria and 40km north of Johannesburg. The physical position of the site is Latitude 25° 53' South, Longitude 27° 42' East. SANSA SO is on land measuring 3000 hectares, and currently has a 135-hectare antenna farm, which is extremely well secured.

The site is situated in a benign environmental location with no significant seismic activity having ever been detected at the location of the SANSA SO. The area is not subject to severe winds or other natural threats such as earthquakes.

Security

SANSA SO is classified as a National Key Point (NKP), it is governed under the NKP Act 102 of 1980.

Under the NKP Act, SANSA SO is required to control, safeguard, and regulate entry at the directorate, therefore access to this facility is restricted to authorised persons only. The site is constantly under surveillance and is monitored by 24-hour security cameras and patrolling guards.

SANSA SO is continually making efforts in improving its security standards, and to ensure the organisation is upholding its security commitments and standards annual compliance audits are conducted.

Environmental Health and Safety

The SANSA SO complies with the Occupational Health and Safety Act 85/1993. SANSA SO has been awarded a 4 star rating for 3 years in succession and it is audited on ISO 9001, ISO 14001 and 45001.

Power

The site has its own power distribution and conversion system. The primary source is 11 kV 1000 kVA 50 Hz supply from the national grid (Eskom). This source in turn gets converted to 230 V (3 Ø, 400 V) 50 Hz. In case of a grid failure, SANSA SO has a Mitsubishi 1000Kva Dynamic rotary UPS that is also backed up by a 1000Kva Generator that can supply full loading within 17 seconds of a detected secondary supply failure.

The national grid is monitored 24/7 and any input voltage fluctuations exceeding 5% result in the Dynamic rotary ups taking full load. In case of the dynamic UPS failure the diesel generator will assume the supply of power until stability is reached in the grid for a minimum of 25 minutes. At this point, the supply of power automatically reverts to the grid. In case of major grid failure, SANSA SO has approximately 40 000 litres of diesel fuel on site, this supply provides roughly 10 days of autonomy.

Two uninterruptible power supply systems of 120 KVA 3 phase supply all critical electronic equipment in the SANSA SO operations room. These two UPS systems can maintain full load power for a minimum of 60 minutes. SANSA SO recently upgraded the UPS system, including controllers, transformers, switch-gear, and batteries, this system has sufficient capacity to provide the required power to the SANSA SO main operations room.

Boresighting Equipment

SANSA SO has a dedicated boresight facilities that ranges between 500m to 24km from the Hartbeeshoek facility. These boresight facilities range between S, X, Ku, DBS and Ka-bands.

Data Communications

Fibre Availability

SANSA has invested in its own last-mile connectivity with an end-to-end communications solution, from SANSA Space Operations in Hartebeeshoek to Teraco Data Centre which is situated in Isando. This investment includes the acquisition of the Dark Fibre Cable, Dense Wave Division Multiplexing (DWDM) equipment and the implementation of a Layer 3 MPLS network. This investment allows SANSA SO to provide Teleport services. The communications services offered are DWDM 10GbE point to point; and MPLS L3 VPNs Connections.

SANSA's presence at Teraco provides our customers with easy access to over 150 local and international carriers, content providers, ISP's, and managed services providers. All undersea cables are accessible from the data centre, thereby improving latency requirements and connecting Africa to the rest of the world.

HBK Power Grid Supply

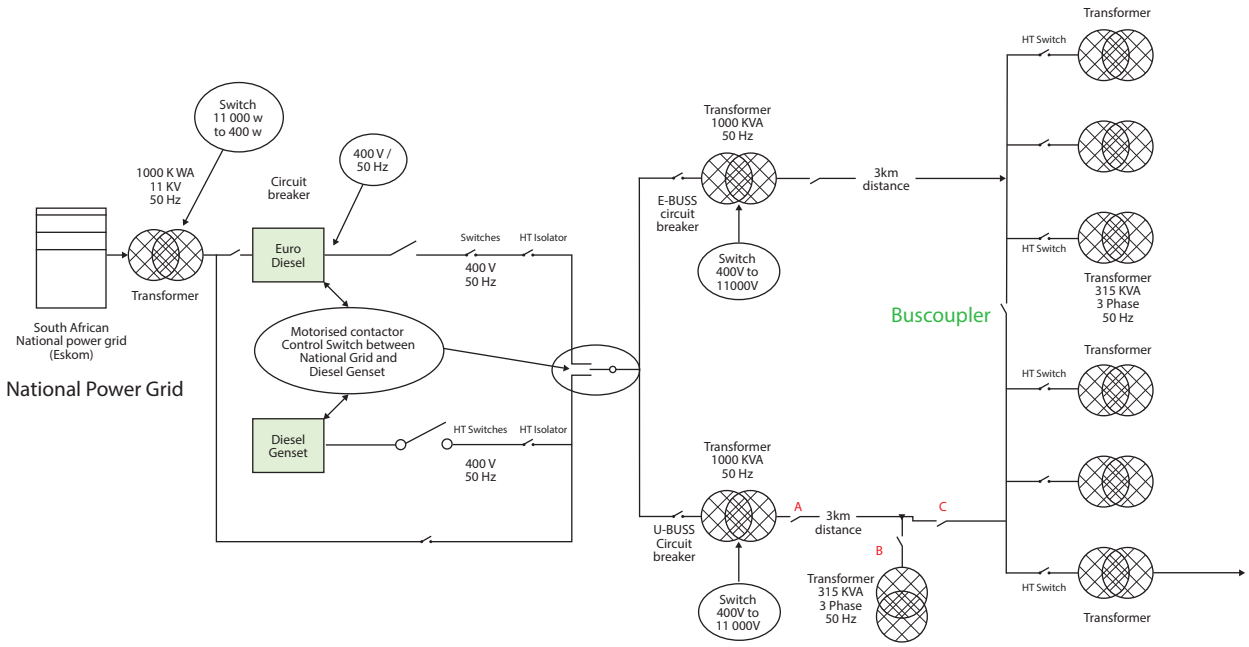


Figure 1: Electrical Diagram of site power generator

Our services run over a private, fibre-optic network that provides point to point connectivity though DWDM network. The primary optic fibre link is protected by Layer 2 MPLS connection provided by the South African National Research Network (SANReN) operated by Tertiary Education and Research Network of South Africa (TENET), for redundancy.

Dedicated cellular phones provide back-up for TT&C voice and fax lines, independent from the SO's power sources and the fibre optic connection. All voice communications services are transported through SIP Trunk connections offered by a Voice over Internet Protocol (VoIP) service provider.

Telkom Fibre

The station is connected to the Telkom Earth Station by 3 x fibre optic cables ducted 2 metres under the ground. This cable is part of the National Fibre Optic Network to which Telkom gives the highest priority whenever maintenance is required. Telkom provides a National Data Network Management Node to the SANSA SO premises for real time monitoring and control of data circuits.

SANReN Network

The station is also connected to the South African National ResearchNetwork (SANReN) by 40Gbps (4 x 10 Gbps) fibre optic cable provided by Telkom.

The Tertiary Education and Research Network of South Africa (TENET) operates the SANReN network providing the South African Higher Education and Research Community with Internet connectivity and value-added services. This network connects over 350 sites – campuses and offices – across all nine South African provinces at an aggregate bandwidth more than one terabit per second (Tbps). Dark fibre metro rings are deployed in most major cities in South Africa.

Several international high-capacity submarine links connect South Africa to Europe (via both the East & West coasts of Africa) and South America. TENET uses multiple submarine circuits to provide intercontinental connectivity, including:

- SEACOM submarine cable that terminates at the SEACOM Landing Station at Mtunzini (and is extended from there redundantly to the SANReN backbone node at Durban), and at the TENET router in Amsterdam.
- West Africa Cable System (WACS) submarine cable that terminates at the SANReN backbone node in Cape Town and at TENET's router at Telecity, London.
- Capacity on both the Eastern Africa Submarine Cable System (EASSy) and South Atlantic 3 (SAT-3/WACS) cable systems is also available via capacity swap arrangements.
- South Atlantic Cable System (SACS) together with Monet and the WACS, provide a more efficient direct connectivity option between North, Central and South America onto Africa, Europe, and Asia.

Peering is available at all major national peering points (NAPAfrica, CINX, JINX, DINX) and internationally at LINX and AMS-IX. Transit services are provided via Liquid Telecom in Cape Town and Johannesburg and via Cogent, NTT and GÉANT in London and Amsterdam. Major deployments of Google and Akamai caches and peering complete the national picture.

Site Access

Access roads at the site are paved and can bear a maximum vehicle load of 60 tonnes. The Johannesburg International Airport is located 80km to the east of the Hartbeeshoek site.

Operations Room

The SANSA SO central operations control room is climate controlled and is where all remote-control computers are located. This control room also houses telecommunications racks, receivers, recorders, timing and frequency sources, GPS equipment and so forth. Floorspace and services is and may be leased to stakeholders in according to their unique requirements.

Mission Control Room

A partitioned area within the Operations room hosts a state-of-the-art video wall, specialized control consoles and is capable of remotely monitoring and controlling the site's antenna systems and hosted infrastructure. The room is manned 24x7. Its efficient design and capabilities allows pro-active and efficient monitoring and an enhanced customer service experience all in an ergonomically friendly environment.

Antenna Systems

A brief summary of the SANSA SO's antenna systems is provided below. Additional information and specifications are available upon request.

1 HBK-2: S-and Ext C-band 12m antenna

Slew rate :	3°/sec
Dish diameter :	12 m
Tracking modes :	Program and Autotrack
Polarisation:	LCP and RCP
Receive	
Frequency range :	2.2 - 2.29 GHz
G/T:	22.4 dB/°K
Transmit 1	
Frequency range :	6.7 – 7.2 GHz
EIRP:	88dBW
Transmit 2	
Frequency range :	2.025 – 2.12 GHz
EIRP:	71dBW

2 HBK-5: 10m Antenna

Slew rate :	10°/sec
Dish diameter :	10 m
Tracking mode :	Program and Autotrack
Polarisation:	LCP and RCP
Receive	
Frequency range :	Rx1: 2.2 - 2.29 GHz Rx2: 8.0 – 8.4 GHz
G/T:	Rx1: 22.5 dB/°K Rx2: 31.0dB/°K
Transmit	
Frequency range:	2.025 – 2.11GHz
EIRP:	64dbw

3 HBK-7: Ku and DBS band Receive/Transmit Antenna

Slew rate :	2 °/sec
Dish diameter :	13.2m
Tracking mode :	Program and Autotrack
Polarisation :	Circular & Linear
Receive	
Frequency Range:	RX1: 10.70-12.50 GHz RX2: 10.95-12.75
G/T :	38.25 dB/°K (@12.75 GHz)
Transmit 1	
Frequency Range:	Tx1 : 12.75-14.5 GHz Tx2: 12.90 -14.5 GHz
EIRP1:	91 dBW (@12.75 GHz) (Phase combined)
Transmit 2	
Frequency Range:	Tx : 17.3-18.1GHz
EIRP2:	92.6 dBW (@ 17.5GHz)

4 HBK-8: Ka band Receive/Transmit Antenna

Slew rate :	2 °/sec
Polarisation :	Circular & Linear
Dish diameter :	13.2m
Receive	
Frequency Range:	17.7 – 21.2 GHz
G/T :	41.8dB/K
Tracking mode :	Program and Autotrack
Transmit	
Frequency Range:	27.5 – 30 GHz
EIRP :	93 dBW

5 HBK-9: X band Receive Antenna

Slew rate :	3°/sec
Dish diameter :	5.4 m
Tracking mode :	Program and Autotrack
Polarisation:	RCP
Receive	
Frequency range :	8.0 – 8.5 GHz
G/T:	30.5dB/°K

6 HBK-10: C Band Antenna (Designated HBK-C15 by intelsat)

Slew rate:	5°/sec Azimuth, 1,4°/sec Elevation
Polarisation:	Circular
Dish diameter:	11 m
Receive	
Frequency range:	3,625–4,2 GHz
G/T:	31,7 dB/K
Tracking mode:	Program and Autotrack
Transmit	
Frequency range:	5,85–6,425 GHz
EIRP:	89.5 dBW

7 MO-1: S Band Mobile Antenna

Slew rate:	20°/sec
Dish diameter:	15 ft
Tracking mode:	Program and Autotrack
Polarisation:	LCP and RCP
Receive	
Frequency range:	2.2 - 2.4 GHz
G/T:	11.6 dB/°K

8 HBK-15: Ku Band Antenna

Slew rate:	1°/sec Azimuth,
Polarisation:	Linear and Circular
Dish diameter:	9 m
Recieve	
Frequency range:	10.7-12.75 GHz
G/T:	37.5 dB/K
Tracking mode:	Program and Autotrack
Transmit	
Frequency range:	13.75-14.5 GHz
EIRP:	88 dBW

9 HBK-16: X Band Antenna

Slew rate:	3°/sec
Dish diameter:	7.3 m
Tracking mode:	Program and Autotrack
Polarisation:	LCP and RCP
Receive	
Frequency range:	8.0 – 8.5 GHz
G/T:	32.2 dB/°K

10 HBK-17: Ku IOT Antenna

Slew rate:	1°/sec Azimuth,
Polarisation:	Linear
Dish diameter:	9 m
Receive	
Frequency range:	10.70-12.75 GHz
G/T:	35 dB/K
Tracking mode:	Program and Autotrack
Transmit	
Frequency range:	TX1 (Ku):12.75 - 14.5 GHz Tx2 (DBS):17.3 - 18.1 GHz
EIRP:	85 dBW

Baseband systems

The station has and continuously seeks out and invests in the latest, state-of-the-art Digital Processing units for the support of telemetry, ranging and commanding with the following formats:

- BPSK, QPSK, PM/PSK demodulation
- Telemetry processing including CCSDS decoding
- Range tone processing
- Command generation, formatting, verification and transmission according to a time tag
- Telemetry simulation and PM/FM modulation
- Range tone compatible with ESA TTC-A-004 and ESA "programmable tone" standards
- Ranging measurement using Telemetry as down-link channel and Command as up-link channel.

Contact Information

For more information on SANSA Space Operations facilities and capabilities please contact:

Tiaan Strydom
Business Development Manager
Phone: +27 12 334 5017
Email: tstrydom@sansa.org.za
Web: www.sansa.org.za