Verification highlights

The main activity of the CTBTO Preparatory Commission is the establishment of a global verification regime capable of detecting nuclear explosions underground, underwater and in the atmosphere. As defined by the Treaty, this regime consists of an International Monitoring System supported by an International Data Centre, consultation and clarification mechanisms, on-site inspections and confidence-building measures, all of which must be operational at the Treaty's entry into force.

IMS network status

The establishment of the International Monitoring System (IMS) network has continued in all four technologies – seismic, hydroacoustic, infrasound and radionuclide. The complete network includes 321 stations and 16 laboratories in 89 countries.

As of 29 June 2007, 208 facilities, including 9 radionuclide laboratories had been certified (i.e. they meet the stringent technical requirements of the CTBTO PrepCom). Of the 321 stations, 248 had been installed and substantially met specifications. A total of 37 stations were either under construction or under contract negotiation, and 108 stations and five radionuclide laboratories had contracts for operation and maintenance.

During the last six months, 17 additional facilities, including five radionuclide laboratories, were certified. Altogether 215 facilities including nine radionuclide laboratories were configured in the International Data Centre (IDC) operational system. Out of these, 191 stations are sending data to the IDC.

By the end of 2008, the Provisional Technical Secretariat expects 90% of the IMS network to be installed. ■

Infrasound station IS11 in Cape Verde: a unique system in a challenging environment

by Dr Andrea Wurm

DIGGING THE TRENCHES FOR THE INFRASOUND ELEMENTS OF IS11, CAPE VERDE, DECEMBER 2006

The monitoring stations of the CTBTO verification regime employ the world's most advanced acoustic, seismic and radionuclide technologies. The 60-station infrasound network that monitors the atmosphere for low frequency sound waves produced by natural or man-made events is the only global monitoring network of its kind.

The stations are often located in remote and inhospitable environments. When installing stations or performing certification tests in such areas, staff members of the Provisional Technical Secretariat (PTS) need to have excellent engineering qualifications and be in good physical condition. This was also true for two PTS infrasound officers, Stefka Stefanova and Alfred Kramer, who had to deal with harsh climatic conditions and challenging technological issues related to the installation and certification of infrasound station IS11 in Cape Verde.

Spread out in the Atlantic Ocean like a jeweled necklace, the ten volcanic islands and five islets comprising Cape Verde were uninhabited when Portuguese mariners discovered the archipelago in 1456. Due to the islands' remote yet strategic position 500 kilometers off the West African coast, Cape Verde became an important hub for the transatlantic slave trade.

With the abolition of the slave trade, Cape Verde's primary source of income vanished. Changing weather patterns, aggravated by deforestation and overgrazing, led over the centuries to severe droughts. In the 20th century alone, repeated droughts caused the deaths of

SALT MARSHES ON MAIO ISLAND

200 000 people and prompted heavy emigration. As a result, Cape Verde's expatriate population is greater than its domestic one, numbering 480 000 people in 2007.

Cape Verde became independent in 1975. By 2007, remittances from emigrants play an important role in the country's service oriented economy, accounting for as much as 20% of GDP. Despite a lack of natural resources (mainly salt and limestone) and the periodic droughts, the country remains prosperous by West African standards. Tourism is the nation's main growth industry.

Cape Verde offers a lot to the interested visitor: a tropical climate with average temperatures ranging from 24°C to 29°C throughout the seasons, spectacular mountain scenery, beautiful extensive beaches, towns with intact colonial architecture and a vibrant Creole culture with breathtaking rhythms – some top world musicians such as Cesaria Evora come from Cape Verde. Every island has its own distinct character, from the lush and lively Santiago to the sandy and dry Maio, and from the volcanic Fogo to the diving paradise of Boa Vista, to name only a few.

The irregular rainfall, resulting in frequent water shortages, also differs greatly from island to island. Sand and dust carried by high winds from the Sahara sometimes cloud the sky and make any activity difficult. This phenomenon is called 'bruma seca' or 'dry fog'. It is particularly intense in the leeward island group which includes Maio, where infrasound station IS11is located.

SATALLITE IMAGES OF CAPE VERDE WITHOUT (LEFT) AND WITH DUST CLOUDS IN THE ATMOSPHERE

Maio has an area of roughly 300 square kilometers and is one of the smallest islands of the archipelago. About 5500 people live there. It is a flat island with mainly white sand beaches and desert like-landscapes with almost no vegetation. The only exception to the arid and barren appearance of the island is a large area of artificially planted acacia trees. This plantation was identified during the January 1999 site survey as an ideal place to build the eight-element infrasound station IS11. The trees and bushes offer good wind protection to the

TYPICAL SCENARY ON MAIO ISLAND

LUSH GREEN VEGATION ON SANTIAGO ISLAND

sensitive infrasound equipment and allow the collection of high quality data.

The CTBTO Preparatory Commission concluded a contract for civil work and equipment installation with the University of Mississippi, which subcontracted infrasound experts from the University of California, San Diego (UCSD), for the implementation.

A heatwave swept across Maio when the installation works started in October 2006. Temperatures of 35°C and more in the shade, plus winds blowing dust from the ground, made the digging for the grounding of the infrasound elements a nightmarish experience. The workers, who had to dig four 12 meter trenches at each of the eight sites, were covered with layers of dust and had difficulty breathing. Dust was everywhere: in the sky, on the ground, on the roads and on their clothes.

The two PTS infrasound officers visited Maio to control the quality of the installation and to perform certification measurements. A pre-installation and a certification visit took place in October and December 2006, respectively. A second certification visit was necessary in April 2007 in order to finalize the work. In a series of tests, the officers assessed the performance of the installed equipment and confirmed that it met the stringent requirements of the CTBTO Preparatory Commission.

During these missions, storms frequently carried sand and dust from the Sahara. The dust descended like fog on the island. Even the sun's rays were obscured by clouds of dust. For several days, everyday life and all outdoor activities on Maio were reduced to a minimum, including the installations at IS11. Flights between the islands were stopped. The tourists and

WORKERS PUTTING THE GRAVEL ON THE INLET PORTS, IS11, CAPE VERDE

WHITE BEACHES ON MAIO ISLAND

the local population were asked to remain indoors because the inhalation of fine dust particles causes stomachache and diarrhea. At IS11, special measures were taken to close and insulate all openings and doors, in order to protect the intrusion of sand and dust inside the equipment vaults and the Central Recording Facility. The solar panels, supplying power to the infrasound elements, needed to be cleaned regularly in order to insure their efficiency.

IS11 has been sending data to Vienna since January 2007. The certification of the station was planned for June. However, due to unexpected interruptions of the data flow, the certification had to be postponed.

Once certified, IS11 will not only provide data to the CTBTO global monitoring network, but may also contribute to a local volcano warning system. The almost 3000 meter high Mount Fogo on nearby Fogo Island is an active volcano that last erupted in 1995. The monitoring of its activities, coordinated by the Civil Engineering Laboratory of Cape Verde (Laboratório de Engenharia Civil de Cabo Verde), will benefit from the high quality infrasound data recorded at IS11. ■

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Infrasound is produced by a variety of natural and man-made sources. Exploding volcanoes, earthquakes, meteors, storms and auroras are among the strongest natural sources. Man-made sources of infrasound include nuclear, mine and large chemical explosions, as well as aircraft and rocket launches.

An infrasound station consists of four to eight array elements, arranged in different geometric patterns. Stations located in high wind areas or on isolated islands require more array elements to improve detection. At each array element sensors are used to measure the pressure changes produced by infrasonic waves. IMS infrasound stations are designed to cover the frequency band from 0.02 Hz to 4 Hz.

INFRASOUND OFFICER PERFORMING MICROBAROMETER COMPARISON TEST (PART OF THE CERTIFICATION MEASUREMENTS)

ARRAY ELEMENT L5 AT IS11, CAPE VERDE