CTBTO
PREPARATORY COMMISSION

COMPREHENSIVE
NUCLEAR-TEST-BAN
TREATY ORGANIZATION

THE **EU'S SPECIAL EFFORT**

PROMOTING **PEACE**, **SECURITY**, AND THE **COMPREHENSIVE NUCLEAR-TEST-BAN TREATY**

THE COMPREHENSIVE NUCLEAR- TEST-BAN TREATY

THE TREATY

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans nuclear test explosions by everyone, everywhere: above ground, under water and underground. This prevents the development and advancement of nuclear weapons while also protecting humans and the environment from radiation risks associated with testing.

While the Treaty is widely supported, it needs ratification from 44 specific countries with nuclear technology capabilities to become international law. As it stands, nine of these States have not yet ratified it. The European Union (EU) and its Member States, all of which have ratified the CTBT, are at the forefront of efforts to secure the remaining commitments.

THE ORGANIZATION

Known formally as the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) and headquartered in Vienna, the Organization's primary mission is to prepare for the Treaty's entry into force. In practical terms, this means making the CTBT internationally legally binding. Today, the CTBTO has two main tasks:

- **Preparing for effective implementation of the Treaty once it enters into force, and**
- **Building up the verification system to ensure that, upon entry into force, no nuclear test explosion can go undetected.**

THE VERIFICATION REGIME HAS SEVERAL ELEMENTS, INCLUDING:

THE INTERNATIONAL MONITORING SYSTEM (IMS)

The IMS is a unique global network using four state-of-the-art technologies: seismic to monitor shockwaves through the ground, hydroacoustic to detect sound waves in the oceans, infrasound to listen for ultra-low-frequency sound waves inaudible to the human ear, and radionuclide to monitor the atmosphere for radioactive particles and gases from a nuclear test explosion.

THE INTERNATIONAL DATA CENTRE (IDC)

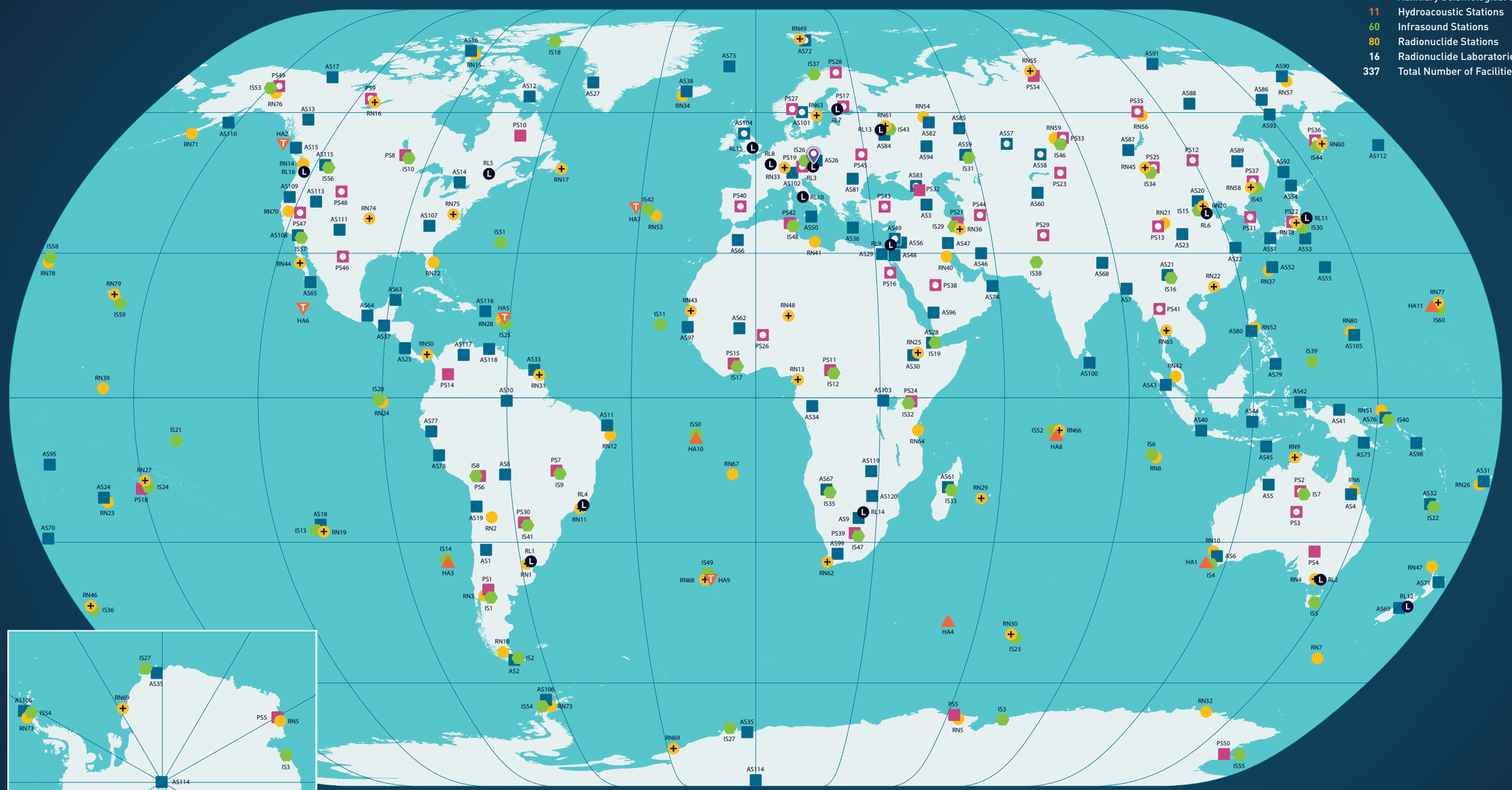
The IDC, located in Vienna, receives, processes, and analyses data collected by the IMS. The IDC swiftly provides States Signatories with essential data about events recorded on the network, such as suspected nuclear detonations. This information includes specifics about the event's location, magnitude, time, and depth.

ON-SITE INSPECTION (OSI)

Once the CTBT enters into force, States Parties can request an On-Site Inspection if the IMS or national verification methods indicate a suspicious event. The inspection process involves gathering on-site evidence, which allows the Organization to confirm the occurrence of a nuclear test explosion and identify the parties responsible for any Treaty violations.

INTERNATIONAL MONITORING SYSTEM

50	Primary Seismological Stations
120	Auxiliary Seismological Stations
11	Hydroacoustic Stations
60	Infrasound Stations
80	Radionuclide Stations
16	Radionuclide Laboratories
337	Total Number of Facilities



Projection from the South Pole, representing accurately the size of Antarctica and the location of the stations in this region

- Seismic Primary Array (PS)
- Seismic Primary 3-Component Station (PS)
- Seismic Auxiliary Array (AS)
- Seismic Auxiliary 3-Component Station (AS)
- Radionuclide Station (RN)
- Radionuclide Station with Noble Gas Monitoring Capabilities (RN)
- Radionuclide Laboratory (RL)
- Hydroacoustic (Hydrophone) Station (HA)
- Hydroacoustic (T-Phase) Station (HA)
- Infrasound Station (IS)
- International Data Centre - CTBTO - Vienna

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EU'S APPROACH TO COMBATING PROLIFERATION OF WEAPONS OF MASS DESTRUCTION

STRENGTHENING EU'S NUCLEAR DISARMAMENT STRATEGY

- CTBTO's expertise significantly contributes to the EU Strategy.
- Global adherence to the nuclear test ban norm prevents the development of nuclear weapons, even before the CTBT's entry into force.
- In this century, only one country has conducted a nuclear weapons test, and States Signatories, including EU Member States, promptly received information about it.
- Apart from detecting nuclear tests, this data has multiple civil and scientific uses. It can be instrumental in providing early earthquake and tsunami warnings, while also contributing to research on climate change, ocean studies, and marine life, ultimately promoting sustainable development and knowledge expansion.

EU and CTBTO session
at 2021 Science and Technology Conference

The EU has a longstanding commitment to non-proliferation, which has played a pivotal role in fostering peace and security. In 2003, the Council of the European Union introduced the non-proliferation clause, also known as the Weapons of Mass Destruction (WMD) clause, to facilitate and advance non-proliferation efforts. Within this strategic framework, the EU has launched a range of programmes firmly rooted in the principles of multilateralism, prevention, and international cooperation.

In line with this approach, the EU's nuclear disarmament strategy actively lends its support to the CTBT.

ENHANCING INTERNATIONAL PEACE AND SECURITY: EU-CTBTO COLLABORATION

The EU has consistently backed the CTBTO, offering both political and financial support. Since 2006, this commitment has been demonstrated through the adoption of various Joint Actions and EU Council Decisions in favour of the Treaty to:

- Strengthen the capabilities of the CTBT monitoring and verification system.
- Empower States Signatories to fulfil their verification duties under the Treaty and fully leverage the benefits of CTBT membership.
- Raise awareness of the CTBT and advocate for its universal adoption and entry into force.

The EU Member States' regular contributions to CTBTO make up about 40 percent of the Organization's total budget. Additionally, the European Union ranks among the leading providers of voluntary funding to the CTBTO.

This brochure highlights the impact of the supplementary funds, which have strengthened the Organization's ability to detect nuclear test explosions by enhancing its verification system and advancing efforts to encourage entry into force through political outreach and capacity building initiatives.

STRENGTHENING CTBTO'S **SEISMIC STATION NETWORK**

FROM LEFT TO RIGHT:
Outdated seismometer removed from borehole at AS097, Babate, Senegal

Testing equipment at AS076, Keravat, Papua New Guinea

TOP:
AS075, Port Moresby, Papua New Guinea

BOTTOM:
Satellite dish installation at AS097, Babate, Senegal

The International Monitoring System (IMS) consists of 50 primary and 120 auxiliary seismic stations, each serving a unique purpose.

Primary seismic stations transmit continuous, near-real-time data to the International Data Centre (IDC) in Vienna, which is accessible to States Signatories. Data from auxiliary seismic stations complements data from primary stations, particularly in cases of suspicious events that may require additional analysis. The former can be obtained upon request.

Under the Treaty, the host State bears the responsibility for the routine operational and maintenance costs of each auxiliary seismic station, including physical security.

However, practical experience has shown that this presents a significant challenge for auxiliary seismic stations in developing countries that are not part of a parent network with a well-established maintenance programme.

To tackle this issue, the European Union has been actively providing vital technical and financial support for the maintenance of auxiliary seismic stations hosted by developing countries or states in transition.

This effort includes initiatives to address issues as they arise, restoring the stations to working order, conducting necessary upgrades, and deploying CTBTO staff to deliver essential technical support.

EXAMPLES OF THIS SUPPORT

- **AS076 in Keravat, Papua New Guinea**
  Upgraded sensors and repaired infrastructure
- **AS118 in Puerto la Cruz, Venezuela**
  Replaced sensors and improved infrastructure
- **AS119 in Lusaka, Zambia**
  Enhanced power sustainability through installation of photovoltaic system

SUPPORTING **NATIONAL DATA CENTRES** (NDCs)

CLOCKWISE:
Capacity Building System (CBS) installation in Uzbekistan, December 2022

National Data Centre (NDC) Capacity building training held in Austria

Kyrgyzstan National Data Centre (NDC) staff installing Capacity Building Systems (CBS)

In the CTBT verification regime, States Signatories play a crucial role. The International Monitoring System (IMS) gathers data, which is shared with States Signatories in two forms:

- → **Data from the IMS facilities, and**
- → **IDC data products, such as event bulletins and analysis reports.**

States Signatories can perform their own analyses through their National Data Centres (NDCs) to assess whether a suspicious event qualifies as a nuclear test explosion.

To promote inclusivity in this decision-making process, the CTBTO offers capacity building programmes that support developing states in establishing and enhancing their expertise within their respective NDCs. Additionally, the Organization is committed to advancing broader geographical representation, multilingualism, and gender parity in participation across these initiatives.

NATIONAL DATA CENTRES-FOR-ALL INITIATIVE (NDCs4All)

The National Data Centres-for-All initiative, launched in 2022, is committed to guaranteeing that all States Signatories enjoy equitable access to IMS data and IDC products. This ensures their active participation in the CTBT verification regime, while also unlocking a wealth of civil and scientific applications.

This initiative helps States without NDCs to establish them. It is funded through the regular budget of the CTBTO and with voluntary contributions from the EU, primarily benefiting developing countries. NDCs4All also offers Capacity Building Systems (CBS) to those who require them.

The Organization not only provides hardware and software resources but also dispatches experts from Vienna to assist with installation while simultaneously offering training to local staff.

The training includes specialised sessions on using the NDC-in-a-box software package, which gives National Data Centres (NDCs) the capability to receive, process and analyse monitoring data, as well as topics relevant to the CTBT, which directly benefits National Authorities.

PROJECT FOR THE PARTICIPATION OF EXPERTS FROM DEVELOPING COUNTRIES, NOW REFERRED TO AS TECHNICAL EXPERTS SUPPORT PROGRAMME (TESP)

The CTBTO launched this project in 2007, initially for a three-year term, which was subsequently extended.

The primary goal of this programme is to encourage experts from developing states, including those classified as least developed countries (LDCs), to participate in technical meetings of the Organization, such as the bi-annual Working Group B sessions. It also aims to foster inclusivity and diversity and encourage substantial contributions to the CTBTO's processes.

TESP operates independently of the regular budget. In recent times, it has received financial contributions from various institutional donors, with the European Union being one of them.

CAPACITY BUILDING, TRAINING, AND WORK-SHOPS

LEFT:
Participants visit IDC Operations Centre during Training Course on NDC Capacity Building (Access and Analysis of Waveform IMS Data and IDC Products), June 2023

RIGHT:
NDC Capacity Building Training Course held in Vienna, Austria, May 2012

Over the years, the European Union has provided funding to support the participation of experts in various training sessions and workshops organised by the CTBTO.

These courses have several objectives:

- → Enhance understanding of the roles of National Data Centres (NDCs) within the verification system.
- → Build and/or improve NDC capabilities by ensuring participants gain the necessary knowledge to access and use International Monitoring System (IMS) data and International Data Centre (IDC) products and software.
- → Provide practical experience in analysing IMS radionuclide and waveform data.

These exchanges enable participants to gain and strengthen skills in working with IMS data and IDC-provided software. They also serve as a valuable platform for gathering feedback, which is instrumental in enhancing the support and technical assistance offered to States Signatories.

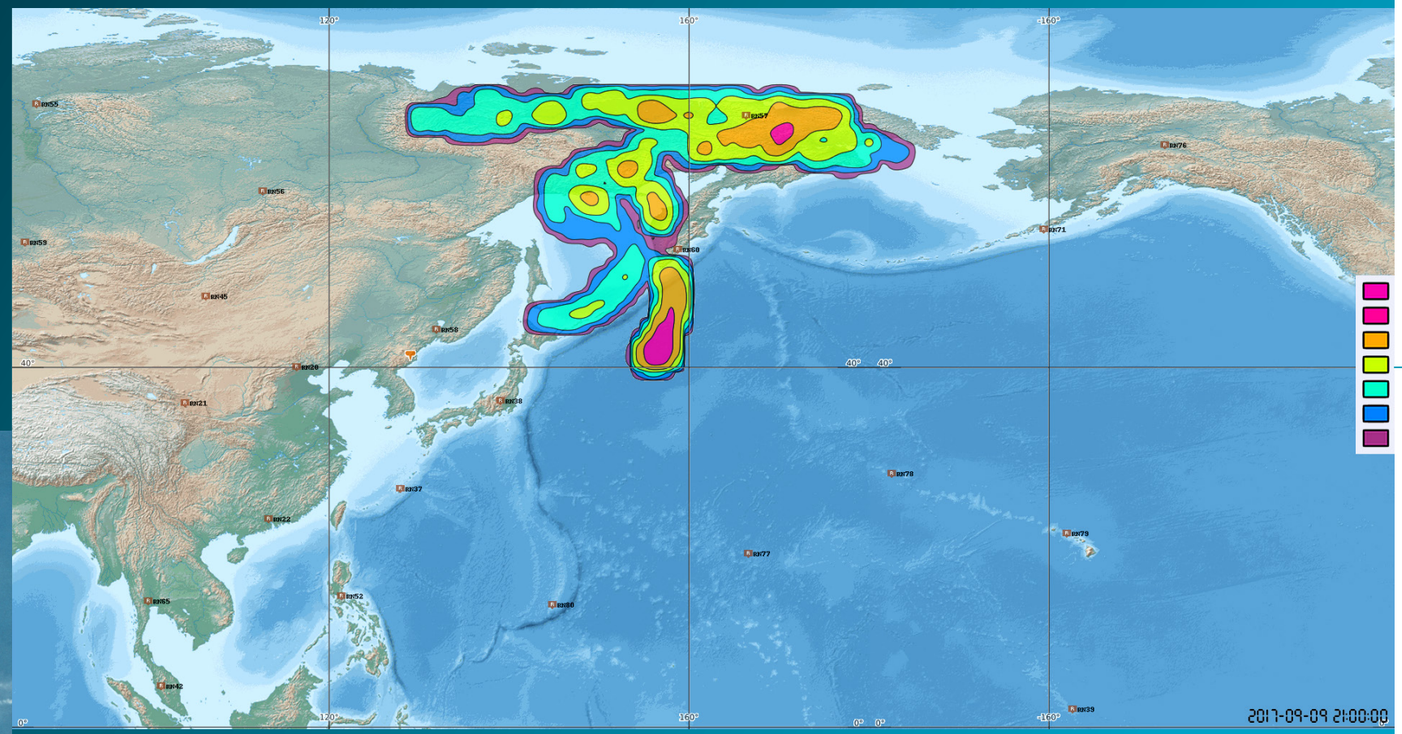
Additionally, these courses encourage interaction between the CTBTO and local staff from States Signatories.

EXAMPLES OF THIS SUPPORT

Training Courses

- → NDC Capacity Building: Access and Analysis of Radionuclide IMS Data and IDC Products
- → NDC Capacity Building: NDC Waveform Training Course (using seismological software, SeisComP3)

IMPROVING **ATMOSPHERIC TRANSPORT MODELLING** (ATM) CAPABILITIES



LEFT:
Hardtack Umbrella nuclear test, 8 June 1958

RIGHT:
ATM Snapshot of North Korea's nuclear test in 2017

In the event of a nuclear test explosion, ATM uses meteorological data to calculate how substances like radionuclides disperse into the atmosphere. This software can trace both the origin and estimate the path of their movement, addressing a crucial question: "Where might they travel next?"

At IMS radionuclide monitoring stations, air masses are sampled and analysed daily to identify any radionuclides that have travelled to the station. However, due to the relatively slow movement of air masses across the globe, it might take several days to detect radionuclides following a release.

This image captured from an ATM simulation reveals the modelled dispersion of noble gases from the 2017 North Korea nuclear test. The colour gradients illustrate the relative concentrations of noble gases suspected to have been released from the explosion site and dispersed into the environment. The colours indicate the estimated magnitudes of these concentrations, with red and orange being the highest, and blue and purple, the lowest.

Efforts are currently underway to enhance ATM capabilities, which involve making software adjustments with support from the European Union.

These developments mark an exciting phase for the field.

Meteorological models are advancing rapidly, and the use of high-performance computers (HPC) is enhancing scientists' capacity to create increasingly accurate models. This results in more detailed findings, ultimately improving our understanding of when and where a release might have occurred.

This data and simulations are made available to States Signatories.

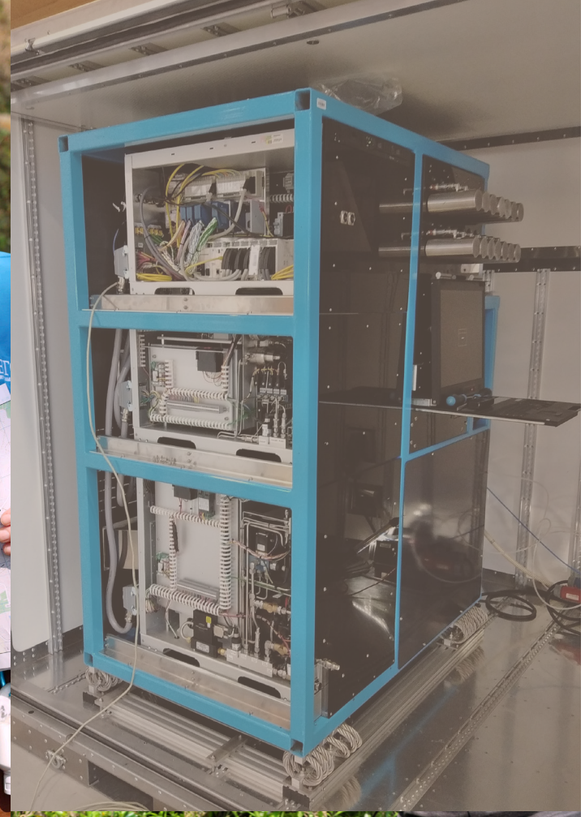
CLOCKWISE:
OSI 24th Regional Introductory Course in Chiang Mai, Thailand, January 2023

Swedish Automatic Unit for Noble Gas Acquisition (SAUNA), also known as SAUNA Field or SAUNA-F 5

Regional Introductory Course in Chiang Mai, Thailand, January 2023

OSI 25th Regional Introductory Course in Bratislava, Slovakia, April 2023

Helicopter with multispectral imagery (MSIR) equipment installed



SUPPORT FOR THE BUILD-UP OF **ON-SITE INSPECTION CAPABILITIES**

Over time, various systems have been developed to collect and analyse radioactive noble gases, with a specific focus on primary radioxenon and radioargon. These gases are crucial indicators in the detection and confirmation of nuclear test explosions because their presence and characteristics can provide valuable insights and evidence related to such activities.

As part of this effort, multiple systems were created to explore the practicality of collecting and analysing noble gases in the field.

One such system is the Swedish Automatic Unit for Noble Gas Acquisition (SAUNA), also known as SAUNA Field or SAUNA-F. Its primary objective is to improve the capabilities of radioactive xenon field laboratory systems.

In 2014, SAUNA-F underwent field testing as part of the Integrated Field Exercise for On-Site Inspection (OSI) in Jordan, referred to as IFE14.

Additionally, the development of multispectral and infrared sensors, designed for installation on helicopters or other aircraft to capture image data at specific frequencies across the electromagnetic spectrum, was funded by the European Union. These sensors were also used during IFE14.

OSI's technical capabilities and equipment will undergo additional testing during IFE25 in Sri Lanka in 2025 and in the lead-up exercises.

EXAMPLES OF OSI TOOLS, EQUIPMENT, AND COURSES FUNDED BY THE EU

- SAUNA-F: A noble gases processing and measurement system for OSI field laboratory
- Multi-spectral and infrared imaging system
- Regional introductory Courses (RICs) held in Thailand and Slovakia

CIVIL AND SCIENTIFIC APPLICATIONS

FROM LEFT TO RIGHT:
Devastation after tsunami in Iwaki, Fukushima, Japan, March 2011

Icebergs in Ilulissat Icefjord, Greenland, September 2014
© UN Photo and Mark Garten

CLOCKWISE: Marine life © Tchami / Hunga Tonga–Hunga Ha'apai Volcano, 2009 / Chelyabinsk Russian Meteor © Sandia Lab

The CTBTO's unique global monitoring system is designed to detect nuclear test explosions anywhere on Earth. This state-of-the-art network is widely recognised as a valuable source of knowledge with diverse applications in civil and scientific domains. It can contribute to our understanding of climate change, ocean dynamics, whale migration, and other important issues.

EARTHQUAKES AND TSUNAMIS

The Organization shares data from more than 150 seismic and hydroacoustic stations with National Tsunami Warning Centres located worldwide. This crucial data supports governments in issuing timely and accurate public alerts.

During the devastating 2011 earthquake and tsunami in Japan, this system played a pivotal role in supporting the disaster response efforts of local authorities.

Today, the CTBTO has tsunami warning agreements with several European Union Member States, including France, Greece, Italy, Portugal, and Spain.

VOLCANIC ERUPTIONS

In January 2022, all 53 certified infrasound stations of the IMS detected the volcanic eruption of Hunga Tonga-Hunga Ha'apai, making it one of the most powerful explosions witnessed in the past century. The event was also captured by multiple hydroacoustic and seismic stations within the network. The eruption produced a wide range of atmospheric waves that encircled the Earth for several days, leading to hazardous tsunamis across the Pacific Ocean and reaching as far as the Indian Ocean, Caribbean Sea, Mediterranean Sea, and the Atlantic Ocean.

CTBTO's infrasound stations' ability to sense very low-frequency sound waves emitted by volcanic eruptions offers the potential for providing near-real-time warnings.

TRACING RADIATION

One day after the 2011 Fukushima nuclear accident, the IMS detected radiological material released from the damaged nuclear power plant.

The network picked up signs of this cloud as it travelled across the globe and passed by several of its stations. Despite the low levels detected, the IMS proved its ability to accurately detect the radiological material.

CTBTO's experts also used Atmospheric Transport Modelling (ATM), enhanced with the financial support of the European Union, to predict the dispersion of the cloud, allowing States Signatories to provide reliable information to concerned populations.

THE VIRTUAL DATA EXPLOITATION CENTRE (VDEC)

The Virtual Data Exploitation Centre (vDEC), funded by the EU, offers scientists and researchers from various disciplines around the world access to CTBTO's data for research and the publication of new findings.

The strong relationship between the scientific and technological community and the CTBTO ensures that the IMS remains at the forefront of technological innovation, leaving no nuclear test explosion undetected.

Examples of Civil and Scientific Applications of CTBTO Data include:

DETECTION AND REAL-TIME WARNING OF

- → Earthquakes and tsunamis
- → Radiation dispersal from nuclear accidents
- → Volcanic eruptions
- → Meteors

RESEARCH ON

- → The Earth's core
- → Climate change
- → Meteorology
- → Break-up of ice shelves and the creation of icebergs
- → Oceans and marine life

NEXT-GEN CTBT: BUILDING A SAFER, MORE SECURE WORLD

LEFT:
CYG member in On-site Inspection (OSI) helicopter at CTBTO TeST Centre during 2022 CTBT Science Diplomacy Symposium

BELOW:
CTBTO Mentoring Programme participants attending 2022 Science Diplomacy Symposium

CTBTO's educational activities and resources focus on developing and maintaining essential awareness and capacity concerning the technical, scientific, legal, and political dimensions of the Treaty and its verification system. By delivering specialised educational courses and using online learning and contemporary media, the CTBTO is broadening the pool of experts beyond conventional stakeholders, whilst also encouraging deeper engagement on critical issues underpinning the Treaty.

To promote the transfer of knowledge to prospective leaders within the CTBT domain and revive discussions on the Treaty, the CTBTO, in partnership with the European Union, supports next-generation-focused activities. One such initiative is the CTBTO Youth Group (CYG), established in 2016. With a membership spanning over 125 countries, the CYG has evolved into a robust platform for fostering peer-to-peer relationships and much-needed dialogue. It facilitates an understanding of the Treaty, its verification regime, and the invaluable benefits it offers to the planet.

Through generous financial backing from the EU, CYG members and other young experts actively participate in major global and regional events. These include the Science and Technology Conference series, Science Diplomacy Symposia, Ministerial Meetings of the Friends of the CTBT, Conferences on Facilitating the Entry into Force of the CTBT, and other activities to promote the Treaty's entry into force.

Furthermore, the European Union supported programmes such as the Citizen Journalism Academy in the past, which empowered young journalists to enhance their communication skills and employ various tools to advocate for a world without nuclear testing. This collaboration with the EU also facilitated initiatives such as the CTBTO Research Fellowship, which offers promising young scholars access to professionals and experts in the field of nuclear non-proliferation and disarmament.

Through the CTBTO Mentoring Programme, EU support also contributes to efforts to nurture early-career women in STEM, particularly those from underrepresented geographical regions. This is achieved by providing them with a combination of exposure to the scientific and technical aspects of the CTBT's verification regime, along with the development of essential soft skills and networking opportunities to advance their professional prospects.

CYG members speaking at panel during 2023 Science and Technology Conference

NEXT-GEN INITIATIVES OVERVIEW

- Revive discussions about the CTBT among decision-makers, scientists, academics, experts, and the media.
- Expand the pool of expertise beyond traditional stakeholders and increase active engagement on the critical issues underpinning the Treaty.
- Create a knowledge hub for future leaders, motivating them to commit to the CTBTO's mission in promoting global peace and security through their professional endeavours.

OUTREACH AND CONNECTIVITY

ADVANCING SCIENCE AND TECHNOLOGY FOR GLOBAL SECURITY

To ensure that the international community and the European Union have an effective and reliable system for detecting all nuclear test explosions, it is crucial that the CTBTO possesses a fully operational verification regime.

Central to this endeavour is the collaboration with the scientific community during the Organization's biennial Science and Technology Conference (SnT). SnTs also play a pivotal role in offering a platform for scientists and researchers to meet, exchange knowledge, and stay abreast of the latest technological advancements.

The EU's representatives actively engage in these events, hosting special sessions that highlight the synergies between the CTBTO and the European Union.

EU and CTBTO session at 2023 Science and Technology Conference

FROM LEFT TO RIGHT:

CTBTO's permanent exhibit at Vienna International Centre (VIC) co-funded by EU

SHOWCASING COMMITMENT TO PEACE AND SECURITY

As a joint effort to increase awareness about the Treaty and its verification system, the EU provided partial funding for a project led by CTBTO's Public Information (PI) Section in 2023.

This initiative involved the installation of a new permanent exhibit at the Vienna International Centre (VIC) to inform the over 50,000 annual visitors about the science and technology used to detect nuclear test explosions.

This exhibit features interactive stations that highlight the achievements of the Comprehensive Nuclear-Test-Ban Treaty and its contributions to global peace and security.

Public Information Section of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)
Vienna International Centre, P.O. Box 1200, 1400 Vienna, Austria | info@ctbto.org | **WWW.CTBTO.ORG**