ANNUAL REPORT 2016

CTBTO
PREPARATORY COMMISSION

#CTBT20

LET'S FINISH
WHAT WE STARTED

THE TREATY

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an international treaty that outlaws all nuclear explosions. By totally banning nuclear testing, the Treaty seeks to constrain the qualitative improvement of nuclear weapons and to end the development of new types of nuclear weapons. It constitutes an effective measure of nuclear disarmament and non-proliferation in all its aspects.

The Treaty was adopted by the United Nations General Assembly and opened for signature in New York on 24 September 1996. On that day, 71 States signed the Treaty. The first State to ratify the Treaty was Fiji on 10 October 1996. The Treaty will enter into force 180 days after it has been ratified by all 44 States listed in its Annex 2.

When the Treaty enters into force, the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) will be established in Vienna, Austria. The mandate of this international organization is to achieve the object and purpose of the Treaty, to ensure the implementation of its provisions, including those for international verification of compliance with it, and to provide a forum for cooperation and consultation among States Parties.

THE COMMISSION

In advance of the entry into force of the Treaty and the establishment of the CTBTO proper, a Preparatory Commission for the organization was established by the States Signatories on 19 November 1996. The Commission was given the mandate of preparing for entry into force.

The Commission, which is located at the Vienna International Centre, has two main activities. The first is to make all necessary preparations to ensure that the Treaty verification regime can be brought into operation at entry into force. The second is the promotion of signature and ratification of the Treaty in order to achieve entry into force.

The Commission is made up of a plenary body responsible for directing policy and comprising all States Signatories, and a Provisional Technical Secretariat to assist the Commission in its duties, both technically and substantively, and carry out such functions as the Commission determines. The Secretariat started work in Vienna on 17 March 1997. It is multinational in composition, with staff recruited from States Signatories on as wide a geographical basis as possible.

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Published by the Provisional Technical Secretariat of the
Preparatory Commission for the
Comprehensive Nuclear-Test-Ban Treaty Organization
Vienna International Centre
P.O. Box 1200
1400 Vienna
Austria

Throughout the document, countries are referred to by the names that were in official use in the period for which the text was compiled.

The boundaries and presentation of material on maps contained in this document do not imply the expression of any opinion on the part of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

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The maps on pages 11–13 and page 15 show the approximate locations of International Monitoring System facilities based on information in Annex 1 to the Protocol to the Treaty adjusted, as appropriate, in accordance with proposed alternative locations that have been approved by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization for reporting to the initial session of the Conference of the States Parties following entry into force of the Treaty.

Printed in Austria
May 2017

Based on document CTBT/ES/2016/5, Annual Report 2016

MESSAGE

FROM THE EXECUTIVE SECRETARY

Coinciding with the 20th anniversary of the opening for signature of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and the establishment of the Preparatory Commission, 2016 was a year of challenges and opportunities.

The Treaty and the work of the Commission received notable recognition and appreciation throughout the year. World leaders and civil society took every opportunity to renew their commitment to the Treaty and their support for the activities of the Commission.

During the 20th anniversary Ministerial Meeting and ministerial round table in Vienna in June, at the eighth Ministerial Meeting of the "Friends of the CTBT" in New York in September, in a statement by the five permanent members of the United Nations Security Council, and at the 71st session of the United Nations General Assembly, national leaders, ministers and other high ranking officials repeatedly voiced their support for the Treaty and called for its entry into force. They welcomed the contribution of the Treaty to the nuclear non-proliferation and disarmament regime. Furthermore, they underlined the achievements of the organization, including the robustness of the verification regime of the Treaty and its scientific and civil applications.

Just before the Ministerial Meeting of the Friends of the CTBT in September, Myanmar and Swaziland deposited their instruments of ratification. With these, the number of ratifications of the Treaty reached 166, making the CTBT one of the most adhered to international instruments in the field of disarmament.

The high point of the year was a historic meeting of the United Nations Security Council on the eve of the 20th anniversary of the Treaty. The Security Council debated the continuing relevance of the Treaty and the importance of pursuing its entry into force and adopted a resolution on the Treaty co-sponsored by 45 countries.

As part of our outreach in 2016, I met with President Roch Marc Christian Kaboré of Burkina Faso, Vice-President Jorge Glas of Ecuador and Prime Minister Benjamin Netanyahu of Israel. I also held talks with foreign ministers and other high ranking state officials of Argentina, Austria, Bangladesh, China, the Comoros, Costa Rica, Cuba, Denmark, Ecuador, Egypt, Ethiopia, France, the Gambia, Germany, the Islamic Republic of Iran, Iraq, Japan, Jordan, Montenegro, Morocco, Pakistan, the Republic of Korea, the Russian Federation, Senegal, Slovakia, Slovenia, Somalia, South Sudan, the Sudan, Turkmenistan, Ukraine, the United States of America and the European Union.

In clear defiance of the established norm against nuclear testing, the Democratic People's Republic of Korea conducted two nuclear tests during the year. The tests, on 6 January and 9 September, once more highlighted the urgency of the entry into force of the Treaty.

I am pleased to note that the performance of the verification system was timely and effective and proved the value of the investment made in its establishment. The announced tests were detected by the International Monitoring System (IMS) facilities and the data were shared with States Signatories in near real time. The States Signatories received the reviewed data products within the defined time lines. The Commission also held briefings to discuss the findings of the verification system.

The response of the IMS and the International Data Centre (IDC) to the two tests established that their capabilities are nearing full maturity. In addition, the tests underlined

the significance of the on-site inspection (OSI) mechanism as a complementary element of our verification regime and the need for constant testing and validation of the regime.

The international reaction to the announced tests was swift and strong. Many countries condemned the nuclear tests and considered such actions to seriously threaten international peace and security. They called on the Democratic People's Republic of Korea to cease any further tests and to immediately sign and ratify the Treaty.

Work on the build-up of the verification system continued. Several important new IMS stations were installed or certified. These included the installation of the last remaining hydroacoustic station HA4, Crozet Islands, France, and radionuclide station RN24, Isla Santa Cruz, Galápagos Islands, Ecuador. In December, the organization certified its first IMS station in China, raising the prospects for further certifications in the country in 2017.

By the end of the year, the total number of certified IMS facilities reached 286, improving both the coverage and the resilience of the network. This figure represents 85% of the network foreseen by the Treaty.

OSI related activities during 2016 focused on the finalization, approval and initial implementation of the OSI action plan for 2016–2019 and the OSI exercise plan for 2016–2020, derived from the review and evaluation process of the 2014 Integrated Field Exercise.

Our capacity building activities, workshops, training courses and educational programmes were expanded to cater to the technical needs of States Signatories, in particular developing countries. These activities aim to assist States Signatories to better fulfil their Treaty obligations and to use the data and products of the verification system more efficiently.

The anniversary year started with the symposium "Science and Diplomacy for Peace and Security: the CTBT@20" in January, which brought together former negotiators of the Treaty, representatives of States Signatories, civil society and the media, and the CTBTO Youth Group. The Youth Group also featured prominently in a panel discussion with United Nations Secretary-General Ban Ki-moon in Vienna in April. In December, youth featured again at an event in Vienna, where the United Nations High Representative for Disarmament Affairs and I joined young people in person and online for a discussion on the Treaty.

States Signatories made several key decisions to further the organizational development of the Commission and to finance important activities. These include, to mention just a few, accepting the statute of the International Civil Service Commission, implementing the new staff compensation package, and providing additional resources for capacity building activities and the establishment of a permanent Equipment Storage and Maintenance Facility. In November, the Commission extended my mandate as Executive Secretary of the organization for an additional four year term starting on 1 August 2017.

This is a brief summary of our collective accomplishments in 2016. The following report presents details of the main activities of the Commission throughout the year. I would like to take this opportunity to express my sincere appreciation to States Signatories for their trust in me and their unwavering commitment to the objectives of the Treaty and the work of the organization.

Lassina Zerbo
Executive Secretary
CTBTO Preparatory Commission
Vienna, March 2017

CONTENTS

ABBREVIATIONS

3-C	three component
ARISE	Atmospheric dynamics Research InfraStructure in Europe
ATM	atmospheric transport modelling
CIF	Capital Investment Fund
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
ECS	Experts Communication System
ESMF	Equipment Storage and Maintenance Facility
EU	European Union
FIMS	field information management system
GCI	Global Communications Infrastructure
IAEA	International Atomic Energy Agency
IDC	International Data Centre
IFE	Integrated Field Exercise
IIMS	Integrated Information Management System
IMS	International Monitoring System
MPLS	multiprotocol label switching
MSIR	multispectral including infrared
NDC	National Data Centre
O&M	operation and maintenance
OPCW	Organisation for the Prohibition of Chemical Weapons
OSC	Operations Support Centre
OSI	on-site inspection
PCA	post-certification activity
PRTool	performance reporting tool
PTE	Proficiency Test Exercise
PTS	Provisional Technical Secretariat
QA/QC	quality assurance and quality control
QMS	Quality Management System
REB	Reviewed Event Bulletin
RRR	Reviewed Radionuclide Report
SAMS	Seismic Aftershock Monitoring System
SEL	Standard Event List
SOP	standard operating procedure
VCDNP	Vienna Center for Disarmament and Non-Proliferation
VIC	Vienna International Centre
VPN	virtual private network
VSAT	very small aperture terminal
WGA	Working Group A
WGB	Working Group B
WMO	World Meteorological Organization
WIN	work instruction

THE INTERNATIONAL MONITORING SYSTEM

HIGHLIGHTS IN 2016

Completion of the installation of the IMS hydroacoustic network

Significant progress in the establishment and certification of new IMS facilities and attaining the milestone of 85% in certification of IMS facilities

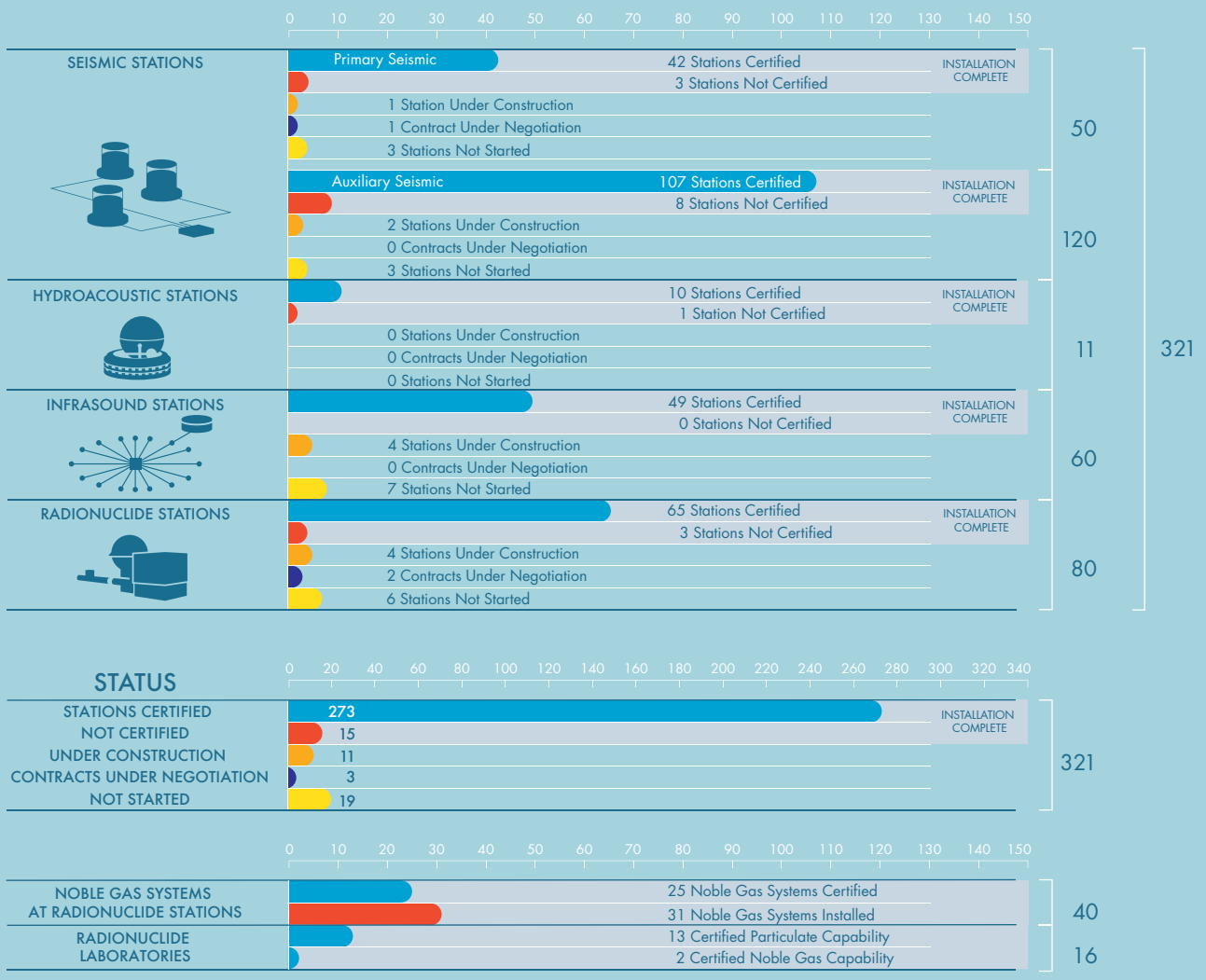
Sustainment of the IMS network and ensuring a high level of data availability

Installation of hydroacoustic station HA4, Crozet Islands (France).

The International Monitoring System (IMS) is a global network of facilities for detecting and providing evidence of possible nuclear explosions. When completed, the IMS will consist of 321 monitoring stations and 16 radionuclide laboratories at locations around the world designated by the Treaty. Many of these locations are remote and difficult to access, posing major engineering and logistical challenges.

The IMS uses seismic, hydroacoustic and infrasound ('waveform') monitoring technologies to detect and locate energy released by an explosion – whether nuclear or non-nuclear – or a natural event that takes place underground, underwater or in the atmosphere.

The IMS uses radionuclide monitoring technologies to collect particles and noble gases from the atmosphere. The acquired samples are analysed for evidence of physical products (radionuclides) that are created by a nuclear explosion and carried through the atmosphere. This analysis can confirm whether an event recorded by the other monitoring technologies was actually a nuclear explosion.



COMPLETING THE INTERNATIONAL MONITORING SYSTEM

Establishment of a station is a general term referring to the building of a station, from its initial stages until its completion. *Installation* typically refers to all work performed until the station is ready to send data to the International Data Centre (IDC) in Vienna. This includes, for instance, site preparation, construction and equipment installation. A station receives *certification* when it meets all technical specifications, including requirements for data authentication and transmission through the Global Communications Infrastructure (GCI) link to the IDC. At this point the station is considered an operational facility of the IMS.

In 2016, following outreach to host States, the Commission made progress in the establishment of stations in a number of States where there had been no or slow progress in the past. The organization also made progress towards the completion of IMS stations in the Russian Federation.

At the end of the year, preparations were under way to certify a combined total of approximately 10 IMS stations, noble gas systems and laboratories in 2017.

China recommenced transmission of data from IMS primary seismic and radionuclide stations for testing and evaluation purposes. Together, China and the Commission made concerted efforts to prepare the upgrade of these stations to IMS specifications in order to certify them as soon as possible. As a major achievement, radionuclide station RN21 was certified in December 2016.

The major installation project for hydroacoustic station HA4, Crozet Islands (France), was completed in December 2016. The planned certification of HA4 in 2017 will mark the completion of the hydroacoustic component of the IMS network.

Additional progress towards the completion of the IMS was made with the installation of radionuclide station RN24 (Ecuador), the certification of infrasound station IS60 (USA), the certification of radionuclide laboratory RL10 (Italy), the certification of the noble gas system at radionuclide station RN19 (Chile) and the certification of

Exhibition on radionuclide station RN21, Lanzhou (China).

the particulate system at radionuclide station RN32 (France). Radionuclide laboratory RL16 (USA) was certified for its capability to analyse noble gas samples.

The total number of certified IMS stations and laboratories thus reached 286 (85% of the network foreseen by the Treaty), improving both the coverage and the resilience of the network.

Monitoring of radionuclide noble gases plays an essential role in the verification system of the Treaty, as was demonstrated following the announced nuclear tests by the Democratic People's Republic of Korea in 2006 and 2013. It also proved to be invaluable following the nuclear accident at Fukushima, Japan, in 2011. In line with its priorities, the Commission continued to focus on the noble gas monitoring programme in 2016. As well as certifying the noble gas system at radionuclide station RN19, it certified the noble gas capability at laboratory RL16 (as noted above).

By the end of the year, 31 noble gas systems were installed (78% of the planned total of 40) at IMS radionuclide stations. Of these, 25 systems were certified as meeting the stringent technical requirements. The addition of these systems significantly strengthens the detection capacity of the IMS network.

The Commission continued its preparations to certify additional IMS laboratories for noble gas measurement capability. The Commission adopted certification requirements and processes for noble gas laboratories in 2012. The first certification of an IMS laboratory for noble gas measurement capability took place in 2014, and the second took place in 2016. The Commission continued to assess the analysis of noble gas data at IMS laboratories through intercomparison exercises. For the first time, these exercises were analysed according to standards used in proficiency test exercises (PTEs). The IMS laboratories demonstrated excellent performance. This new functionality is crucial for the quality assurance and quality control (QA/QC) of IMS noble gas measurements.

All of these advancements contribute to the prospect of the completion of the IMS network.

AGREEMENTS FOR MONITORING FACILITIES

The Commission has the mandate to establish procedures and a formal basis for the provisional operation of the IMS before the Treaty enters into force. This includes concluding agreements or arrangements with States that host IMS facilities to regulate activities such as site surveys, installation or upgrading work, certification and post-certification activities (PCAs).

In order to efficiently and effectively establish and sustain the IMS, the Commission needs to fully benefit from the immunities to which it is entitled as an international organization, including exemption from taxes and duties. Consequently, facility agreements or arrangements provide for the application (with changes where appropriate) of the Convention on the Privileges and Immunities of the United Nations to the activities of the Commission or explicitly list the privileges and immunities of the Commission. This may require a State that hosts one or more IMS facilities to adopt national measures to bring these privileges and immunities into effect.

In 2016, the Commission continued to address the importance of concluding facility agreements and arrangements and their subsequent national implementation. The absence of such legal mechanisms in some cases results in substantial costs (including in human resources) and major delays in sustaining certified IMS facilities. These costs and delays adversely affect the availability of data from the verification system.

Of the 89 States that host IMS facilities, 49 have signed a facility agreement or arrangement with the Commission, and 40 of these agreements and arrangements are in force. At the end of 2016, the Commission was in negotiation with 4 of the 40 host States that had not yet concluded a facility agreement or arrangement. States are showing increased interest in this subject, and it is hoped that ongoing negotiations will be concluded in the near future and that negotiations with other States may be initiated soon.

POST-CERTIFICATION ACTIVITIES

Following the certification of a station and its incorporation into the IMS, its operation focuses on the delivery of high quality data to the IDC.

PCA contracts are fixed cost contracts between the Commission and some station operators. These contracts cover station operations and various preventive maintenance activities. The total expenditure of the Commission related to PCAs in 2016 was US$17 775 324. This amount covers the costs related to PCAs for 165 facilities and noble gas systems.

Each station operator submits a monthly report on PCA performance,

Radionuclide station RN32, Dumont d'Urville, Antarctica (France).

Installation of hydroacoustic station HA4, Crozet Islands (France).

which the Provisional Technical Secretariat (PTS) reviews for compliance with operation and maintenance (O&M) plans. The Commission has developed standardized criteria for the review and evaluation of the performance of station operators.

The Commission continued to standardize the services provided under PCA contracts. It requested operators of all newly certified stations and of existing stations that submitted new budget proposals to develop O&M plans in accordance with a standard template. In 2016, O&M plans for two stations were submitted in the standard format. This brought the number of stations under PCA contracts with O&M plans in the standard format to 104.

SUSTAINING PERFORMANCE

Preparing a global monitoring system of 337 facilities supplemented by 40 noble gas systems involves much more than just the building of stations. It requires a holistic approach to establishing and sustaining an intricate 'system of systems' that should be completed to meet the verification requirements of the Treaty while protecting the investment already made by the Commission. This can be achieved by testing, evaluating and sustaining what is in place, and then further improving on this.

The life cycle of the IMS station network proceeds from conceptual design and installation to operation, sustainment, disposal and rebuild. Sustainment covers maintenance through necessary preventive maintenance, repairs, replacement, upgrades and continuous improvements to ensure the technological relevance of the monitoring capabilities. This process also involves management, coordination and support for the full life cycle of each facility component, performed as efficiently and effectively as possible. In addition, as IMS facilities reach the end of their designed life cycle, there is the need to plan, manage and optimize the recapitalization (i.e. replacement) of all components of each facility in order to minimize downtime and optimize resources.

Infrasound station IS18, Qaanaaq, Greenland (Denmark).

The support activities for IMS facilities in 2016 continued to focus on preventing interruptions to the flow of data. They also aimed at preventive and corrective maintenance and recapitalization of IMS stations and station components as they reach the end of their life cycle. The Commission enhanced its efforts to develop and implement engineering solutions to improve the robustness and resilience of IMS facilities.

Optimizing and enhancing performance also involves the continuous improvement of data quality, reliability and resilience. Hence the Commission continued to emphasize QA/QC, state of health monitoring, IMS facility calibration activities (which are essential for the reliable interpretation of detected signals) and improvement of IMS technologies. These activities contribute to maintaining a credible and technologically relevant monitoring system.

LOGISTICS

The support required to ensure the highest levels of data availability from a global network of facilities such as the IMS calls for an integrated approach to logistics that seeks continuous validation and optimization. In 2016, the Commission completed an in depth assessment of its logistics requirements in three key areas (shipment of equipment and goods, warehousing and asset management) and started establishing a PTS-wide integrated logistics support structure to undertake these tasks.

The Commission also further developed its capability for logistics support analysis in order to strive for the highest possible levels of data availability at optimal cost. With over 280 certified IMS facilities around the world, often in remote sites, maintaining the highest levels of data availability requires continuous analysis, refinement and validation of IMS station life cycle costs and reliability variables. During 2016, the Commission continued its efforts to refine and validate models, with the aim of improving planning for the sustainment of the IMS network.

Effective configuration management strengthens overall confidence that IMS monitoring facilities meet IMS technical specifications and other requirements

Infrasound station IS57, Piñon Flat, California (USA).

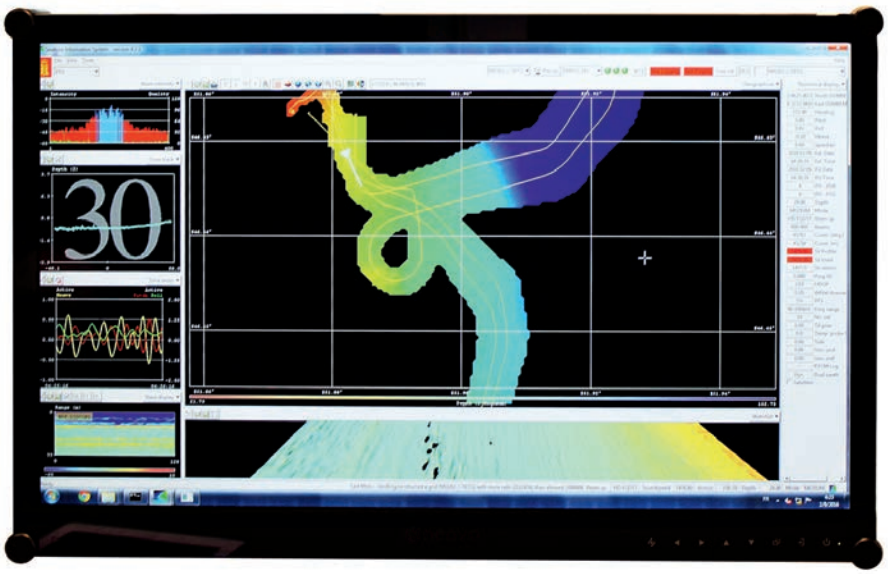
Infrasound station IS37, Bardufoss (Norway).

for certification. It ensures that changes at stations are rigorously assessed to determine their effect and, when the changes are implemented, reduces costs, effort and unforeseen drops in data availability.

In this context the Commission continued to implement and improve the internal IMS configuration management procedures that had been introduced at the end of 2013. It also worked with host States and station operators to further streamline State specific shipment procedures for IMS equipment and consumables and ensure their timely and cost free customs clearance. Nonetheless, shipping and customs clearance processes continued to be very time consuming and resource intensive. This increases the time to repair an IMS station and reduces the data availability of that station. The Commission therefore continued to analyse and optimize the availability of IMS equipment and consumables at IMS stations, at its regional depots, at supplier depots and at the depot in Vienna.

MAINTENANCE

The PTS provides maintenance support and technical assistance at IMS facilities around the globe. During 2016, numerous maintenance requests were addressed, including long running data availability problems at eight IMS facilities. The PTS also conducted preventive and corrective maintenance visits at 13 certified IMS facilities. This low figure reflects an increased reliance on station operators, contractors and other sources of support to perform such tasks, following the strategy of the PTS.



Data from hydroacoustic station HA4, Crozet Islands (France).

The Commission continued to establish and manage long term support contracts with manufacturers of IMS equipment and support providers. Some of these contracts were used to address support requirements for on-site inspection (OSI). In addition, the organization established and maintained a number of contracts with suppliers of equipment, material and technical services on a call-off basis. Both long term and call-off contracts ensure that necessary support can be provided to IMS monitoring stations in a timely and efficient manner.

As the entity closest to an IMS facility, the station operator is in the best position to prevent problems at stations and ensure timely resolution of any problems that occur. In 2016, the Commission continued to emphasize development of the technical capabilities of station operators. As well as technical training for operators, station visits by PTS staff included hands on training for local staff, with the aim of avoiding the need for PTS staff to travel from Vienna to resolve problems.

Up to date and reliable technical documentation for each IMS station is essential to ensure its sustainability and to maintain a high level of data availability. In 2016, the Commission made substantial progress populating the PTS Quality Management System (QMS) with station specific documentation. By the end of 2016, full sets of documentation had been developed for 26 stations, and partial information had been acquired for an additional 19 stations.

The combination of technical training for station operators, better coordination between the operators and the Commission to optimize PCA contracts, and improved station specific O&M plans and station information

Installation of radionuclide station RN21, Lanzhou (China).

Preparation of a radionuclide sample at RN24, Isla Santa Cruz, Galápagos Islands (Ecuador).

contributed to enhancing the capability of station operators to undertake more sophisticated maintenance tasks at their stations. This is essential for optimizing the sustainment and performance of the IMS network.

RECAPITALIZATION

The final phase in the life cycle of equipment for IMS facilities involves its replacement (known as recapitalization) and disposal. In 2016, the Commission continued to recapitalize IMS facility components as they reached the planned end of their operational life cycles.

In managing recapitalization, the Commission and station operators took into account both life cycle data and station specific failure analysis and risk assessment. To optimize the obsolescence management of the IMS network and associated resources, the Commission continued to prioritize the recapitalization of components with high failure rates or risks and components whose failure would cause significant downtime. At the same time, recapitalization of components that proved to be robust and reliable was delayed beyond the planned end of their operational life cycles, where suitable, in order to optimize the use of available resources.

Several recapitalization projects were completed at certified IMS facilities in 2016, involving substantial investment of human and financial resources. In three cases (PS28 (Norway), IS18 (Denmark) and IS57 (USA)) recapitalization was followed by revalidation to ensure that the stations continued to meet technical requirements. Major upgrades of noble gas systems at two certified radionuclide stations (RN11 (Brazil) and RN75 (USA)) were also completed.

ENGINEERING SOLUTIONS

The engineering and development programme for IMS facilities aims to improve the overall availability and quality of data and the cost effectiveness and performance of the IMS network by designing, validating and implementing solutions. Systems engineering is implemented throughout the life cycle of an IMS station and relies on open systems design through standardization of interfaces and modularity. It aims to improve systems and the reliability, maintainability, logistical supportability, operability and testability of equipment. Engineering and development solutions consider both end to end systems engineering of stations and optimized interaction with data processing by the IDC.

In 2016, the Commission carried out several complex repairs, requiring substantial engineering work, to return stations to operation. Improvements to infrastructure and equipment were implemented at several certified IMS facilities to improve their performance and resilience. Engineering solutions were also deployed to minimize station downtime during upgrades.

The Commission continued its work to optimize the performance of the IMS facilities and the monitoring technologies. Analysis of station failures helped identify the main causes of data loss and assisted the subsequent analysis of the subsystem failures responsible for downtime. In particular, in 2016 the Commission carried out trend analyses of the downtime of each subsystem for all waveform technologies. It also continued systematic failure analysis based on incident reports for the radionuclide particulate and noble gas systems. The outcome of these activities provided valuable input to prioritize the design, validation and implementation of improvements for IMS stations and technologies.

In 2016, the Commission concentrated its engineering efforts on the following:

- Signing of call-off contracts for equipment and services support

for high resolution digitizers, communication systems, infrasound sensors, metrological services and software engineering services;

- Implementation of in situ calibration capability at a second IMS infrasound station (IS37, Norway);
- Conduct of the second pilot interlaboratory comparison study for infrasound technology as a major step towards achieving traceability to a standard with support from national metrology institutes;
- Assessment of the next generation of hydroacoustic stations and potential temporary solutions;
- Continued improvement of high purity germanium detectors, with the testing of hardened detector design with improved vacuum.

In addition, four next generation noble gas systems are currently under development. All systems will undergo testing against IMS certification requirements and must demonstrate operation at 95% data availability for one year prior to deployment in the IMS. The PTS inspected the Russian MIKS system and reviewed data from test operation of this system.

The PTS tested prototype software for automated analysis of noble gas state of health data. The software will assist in identifying system failures and in predicting failures in order to initiate preventive maintenance.

A project to review power requirements and standards for IMS radionuclide stations was initiated. Poor power quality has been identified as one of the root causes of station downtime. The project aims to establish specifications for power requirements and propose solutions for power improvements that are applicable to all IMS sites.

Testing of a prototype silicon PIN high resolution beta–gamma detector for noble gas measurements continued. A silicon PIN detector system has been combined with a SAUNA system for test purposes. This technology offers in particular improved discrimination between metastable xenon isotopes.

These initiatives further improved the reliability and resilience of IMS facilities. They also enhanced the performance of the network and increased the robustness of IMS stations, thus contributing to the extension of their life cycles and containing the risks of data downtime. Moreover, they increased the quality of data processing and of data products.

AUXILIARY SEISMIC NETWORK

The Commission continued to monitor the operation and sustainment of auxiliary seismic stations in 2016. The data availability of auxiliary seismic stations was maintained during the year.

In accordance with the Treaty, the regular O&M costs of each auxiliary seismic station, including the cost of physical security, are the responsibility of the State hosting it. However, practice has shown that this constitutes a significant challenge for auxiliary seismic stations in developing countries that do not belong to a parent network with an established maintenance programme.

The Commission has encouraged States that host auxiliary seismic stations with design deficiencies or with problems related to obsolescence to review their ability to cover the cost of upgrading and sustaining their stations. However, obtaining the appropriate level of technical and financial support remains difficult for several host States.

To address this, in 2016 the European Union (EU) continued to support the sustainment of auxiliary seismic stations that are hosted by developing countries or countries in transition. This initiative includes action to return stations to an operational state and the provision of transportation and funds for additional PTS personnel to provide technical support. The Commission continued its discussions with other States whose parent networks include several auxiliary seismic stations in order to make similar arrangements.

QUALITY ASSURANCE

In addition to improving performance at individual stations, the Commission accords great importance to ensuring the reliability of the IMS network as a whole. Hence, its engineering and development activities in 2016 continued to focus on measures for data surety and calibration.

The Commission further developed its calibration methodologies. In particular, it performed its second full frequency on-site calibration of an infrasound station (IS37, Norway). Also, calibration of all hydroacoustic T-phase stations has been fully integrated into the seismic calibration schedule. In addition, the Commission continued the scheduled calibration of primary and auxiliary seismic stations and advanced the deployment of the standard station interface calibration module throughout the IMS seismic network.

Calibration plays a significant role in the verification system, as it determines and monitors parameters needed to properly interpret signals recorded by IMS facilities. It does this either by direct measurement or by comparison against a standard.

The QA/QC programme for radionuclide laboratories consisted of interlaboratory comparison activities. The Commission assessed the 2015 PTE and conducted the 2016 PTE, which involved analysis of test samples in the geometry of RASA automatic systems. The Commission also undertook a laboratory surveillance visit to radionuclide laboratory RL5 (Canada).

QA/QC activities for noble gas continued with the execution of three intercomparison exercises for the noble gas capability of radionuclide laboratories.

In an ever growing but also ageing IMS network, ensuring data availability is a daunting task. However, through close cooperation, all stakeholders – station operators, host States, contractors, States Signatories and the Commission – worked hard to ensure the solid and effective performance of the network.

PROFILES OF THE MONITORING TECHNOLOGIES

170 STATIONS
50 primary
120 auxiliary

76 COUNTRIES

SEISMIC STATIONS

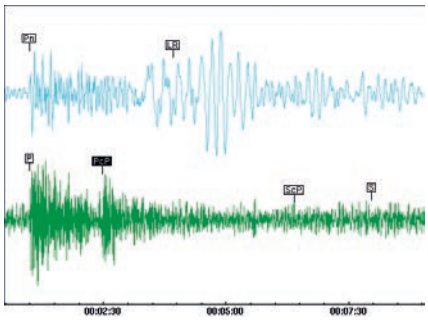
The objective of seismic monitoring is to detect and locate underground nuclear explosions. Earthquakes and other natural events as well as anthropogenic events generate two main types of seismic wave: body waves and surface waves. The faster body waves travel through the interior of the earth, while the slower surface waves travel along its surface. Both types of wave are looked at during analysis to collect specific information on a particular event.

Seismic technology is very efficient at detecting a suspected nuclear explosion, as seismic waves travel fast and can be registered within minutes of an event. Data from seismic stations of the IMS provide information on the location of a suspected underground nuclear explosion and help identify the area for an OSI.

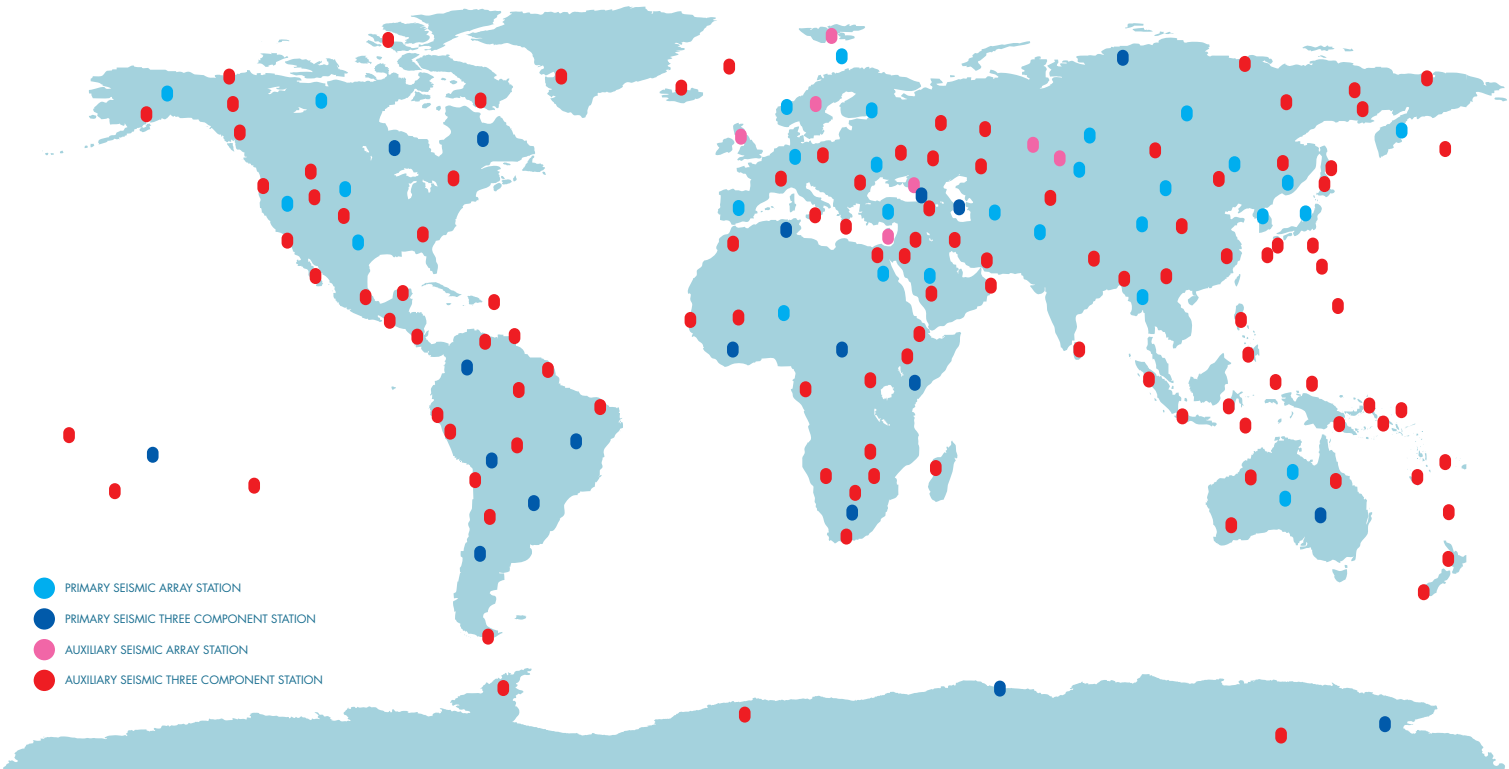
The IMS has primary and auxiliary seismic stations. Primary seismic stations send continuous data in near real time to the IDC. Auxiliary seismic stations provide data on request from the IDC.

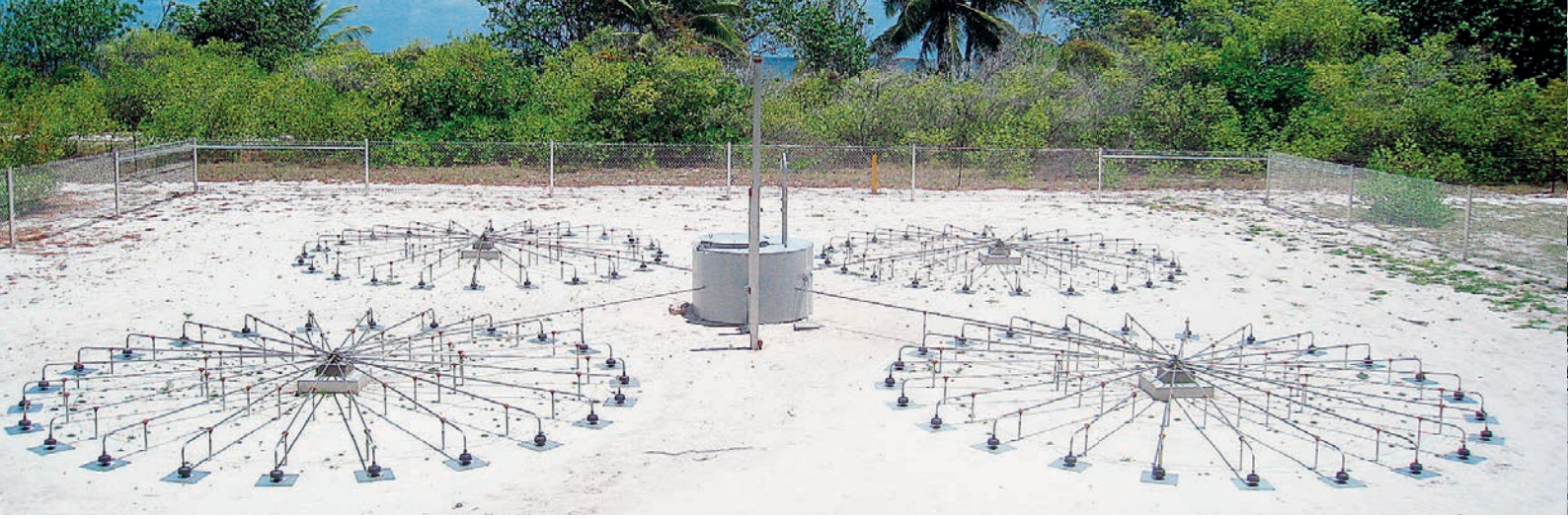
An IMS seismic station typically has three basic parts: a seismometer to measure ground motion, a system to record the data digitally with an accurate time stamp, and a communication system interface.

An IMS seismic station can be either a three component (3-C) station or an array station. A 3-C station records broadband ground motion in three orthogonal directions. An array station generally consists of multiple short period seismometers and 3-C broadband instruments that are separated spatially. The primary seismic network is mostly composed of arrays (30 of 50 stations), while the auxiliary seismic network is mostly composed of 3-C stations (112 of 120 stations).



Example of seismic waveform.





60 STATIONS

34 COUNTRIES

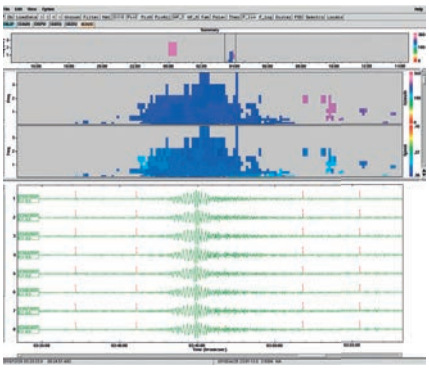
INFRASOUND STATIONS

Acoustic waves with very low frequencies, below the frequency band audible to the human ear, are called infrasound. Infrasound is produced by a variety of natural and anthropogenic sources. Atmospheric and shallow underground nuclear explosions can generate infrasound waves that may be detected by the infrasound monitoring network of the IMS.

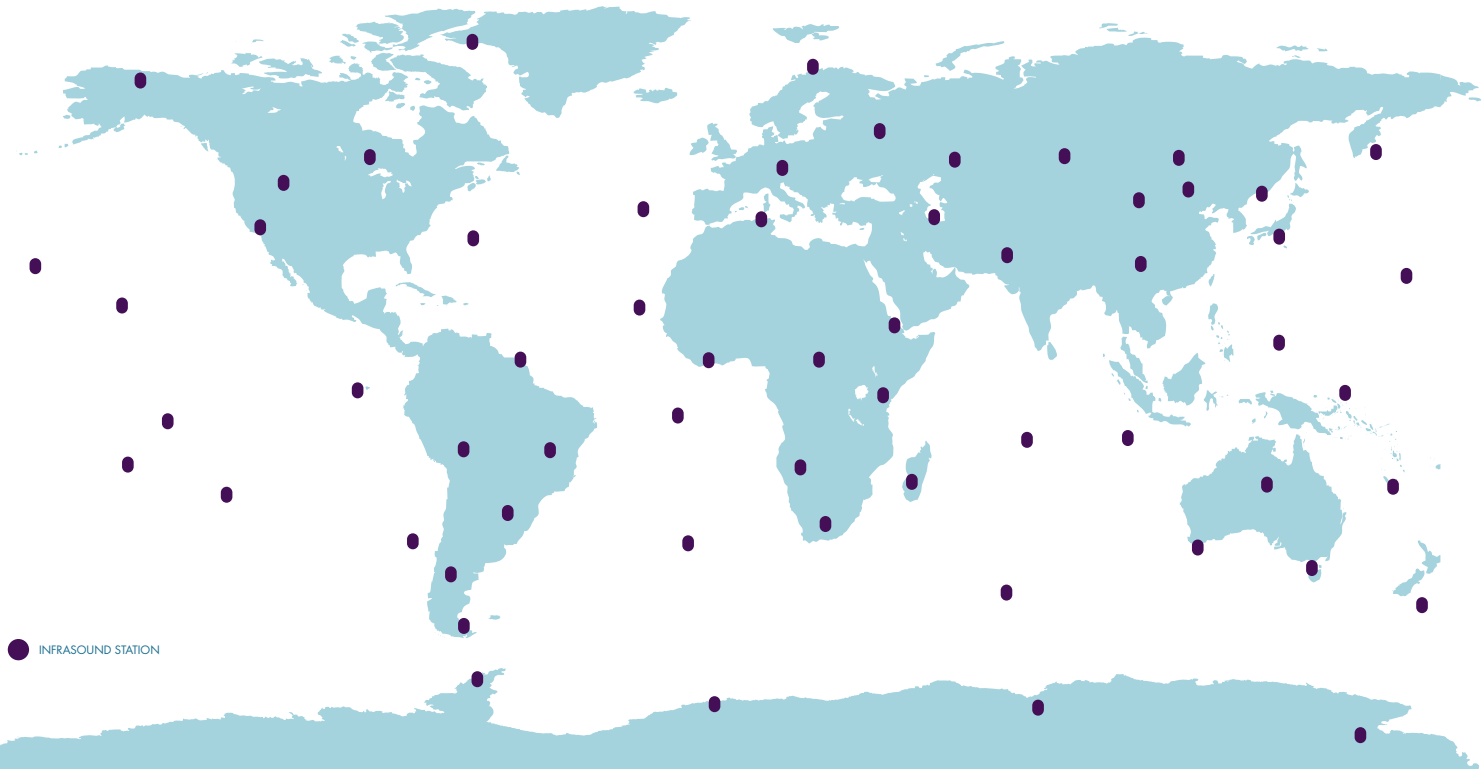
Infrasound waves cause minute changes in the atmospheric pressure that are measured by microbarometers. Infrasound has the ability to cover long distances with little dissipation, which is why infrasound monitoring is a useful technique for detecting and locating atmospheric nuclear explosions. In addition, since underground nuclear explosions also generate infrasound, the combined use of the infrasound and seismic technologies enhances the ability of the IMS to identify possible underground tests.

The IMS infrasound stations exist in a wide variety of environments, ranging from equatorial rainforests to remote windswept islands and polar ice shelves. However, an ideal site for deploying an infrasound station is within a dense forest, where it is protected from prevailing winds, or at a location with the lowest possible background noise in order to improve signal detection.

An IMS infrasound station (also known as an array) typically employs several infrasound array elements arranged in different geometrical patterns, a meteorological station, a system for reducing wind noise, a central processing facility and a communication system for the transmission of data.



Example of infrasound waveform.



11 STATIONS
6 underwater
5 on land

8 COUNTRIES

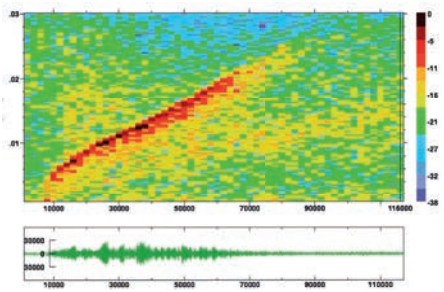
HYDROACOUSTIC STATIONS

Nuclear explosions underwater, in the atmosphere near the ocean surface or underground near oceanic coasts generate sound waves that can be detected by the IMS hydroacoustic monitoring network.

Hydroacoustic monitoring involves recording signals that show changes in water pressure generated by sound waves in the water. Owing to the efficient transmission of sound through water, even comparatively small signals are readily detectable at large distances. Thus 11 stations are sufficient to monitor most of the world's oceans.

There are two types of hydroacoustic station: underwater hydrophone stations and T phase stations on islands or on the coast. The underwater hydrophone stations are among the most challenging and most costly monitoring stations to build. They must be designed to function in extremely inhospitable environments, exposed to temperatures close to freezing point, huge pressure and saline corrosiveness.

The deployment of the underwater parts of a hydrophone station (i.e. placing the hydrophones and laying the cables) is a complex undertaking. It involves the hiring of ships, extensive underwater work, and the use of specially designed material and equipment.



Example of hydroacoustic waveform.

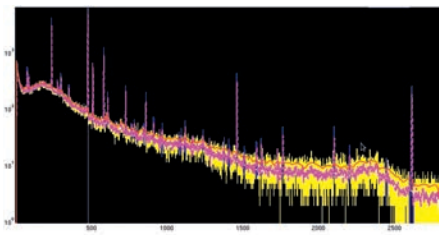
96 FACILITIES
80 stations
16 laboratories

41 COUNTRIES

RADIONUCLIDE PARTICULATE STATIONS

Radionuclide monitoring technology complements the three waveform technologies employed in the Treaty verification regime. It is the only technology that is able to confirm whether an explosion detected and located by the waveform methods is indicative of a nuclear test. It provides the means to identify the 'smoking gun' whose existence would be evidence of a possible violation of the Treaty.

Radionuclide stations detect radionuclide particles in the air. Each station contains an air sampler, detection equipment, computers and a communication set-up. At the air sampler, air is forced through a filter, which retains most particles that reach it. The used filters are examined and the gamma radiation spectra resulting from this examination are sent to the IDC in Vienna for analysis.



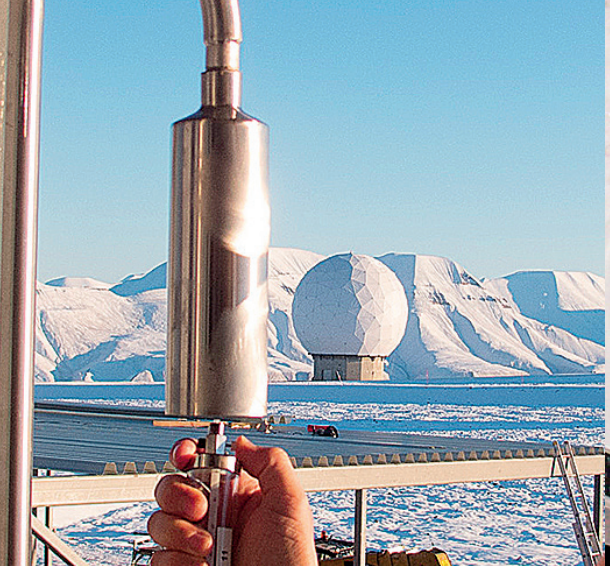
Example of gamma spectra.

NOBLE GAS DETECTION SYSTEMS

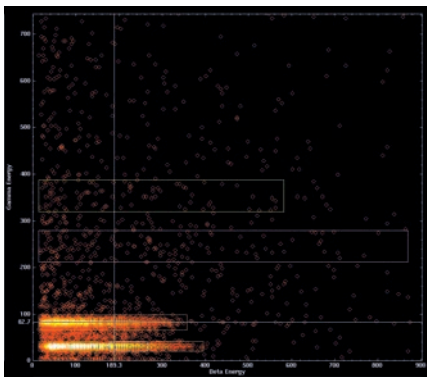
The Treaty requires that, by the time it enters into force, 40 of the 80 IMS radionuclide particulate stations also have the capability to detect radioactive forms of noble gases such as xenon and argon. Special detection systems have therefore been developed and are being deployed and tested in the radionuclide monitoring network before they are integrated into routine operations.

Noble gases are inert and rarely react with other chemical elements. Like other elements, noble gases have various naturally occurring isotopes, some of which are unstable and emit radiation. There are also radioactive noble gas isotopes that do not occur naturally but which can be produced only by nuclear reactions. By virtue of their nuclear properties, four isotopes of the noble gas xenon are particularly relevant to the detection of nuclear explosions. Radioactive xenon from a well contained underground nuclear explosion can seep through layers of rock, escape into the atmosphere and be detected later, thousands of kilometres away.

All of the noble gas detection systems in the IMS work in a similar way. Air is pumped into a charcoal-containing purification device in which xenon is isolated. Contaminants of different



kinds, such as dust, water vapour and other chemical elements, are eliminated. The resulting air contains higher concentrations of xenon, in both its stable and unstable (i.e. radioactive) forms. The radioactivity of the isolated and concentrated xenon is measured and the resulting spectrum is sent to the IDC for further analysis.

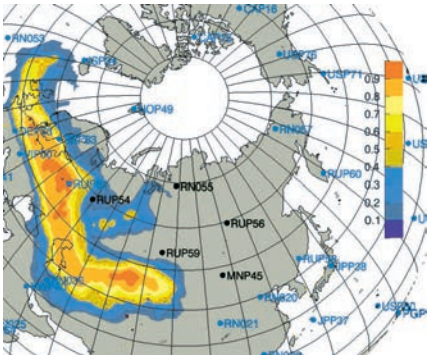


Example of beta–gamma spectra.

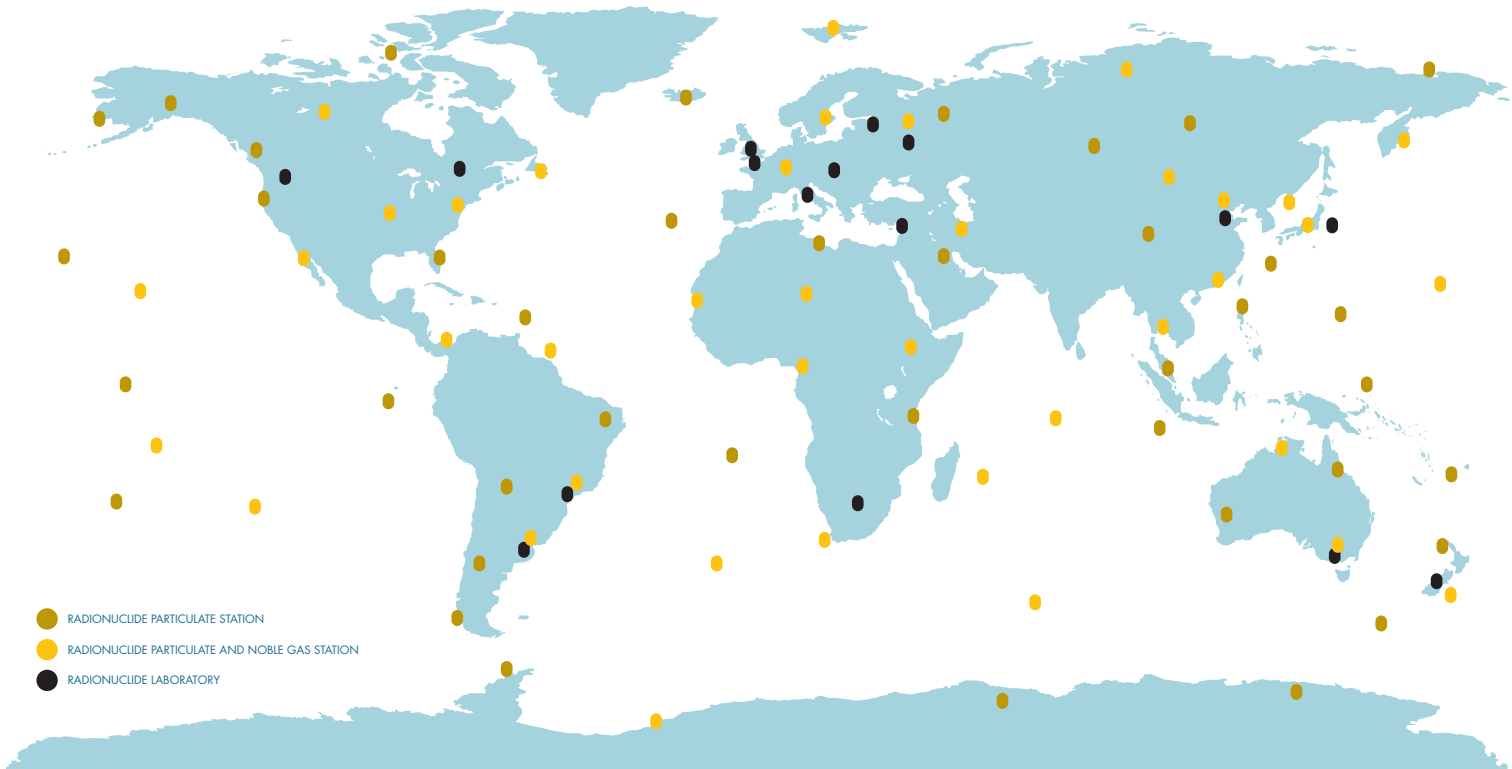
RADIONUCLIDE LABORATORIES

Sixteen radionuclide laboratories, each located in a different State, support the IMS network of radionuclide monitoring stations. These laboratories have an important role in corroborating the results from an IMS station, in particular to confirm the presence of fission products or activation products that could be indicative of a nuclear test. In addition, they contribute to the quality control of station measurements and the assessment of network performance through regular analysis of routine samples from all certified IMS stations. These world class laboratories also analyse other types of sample, such as those collected during a station site survey or certification.

The radionuclide laboratories are certified under rigid requirements for analysis of gamma spectra. The certification process provides assurance that the results provided by a laboratory are accurate and valid. These laboratories also participate in the annual PTEs organized by the Commission. In addition, certification of IMS radionuclide laboratories for noble gas analysis capability started in 2014.



Example of atmospheric transport modelling.



THE GLOBAL COMMUNICATIONS INFRASTRUCTURE

HIGHLIGHTS IN 2016

High GCI availability maintained

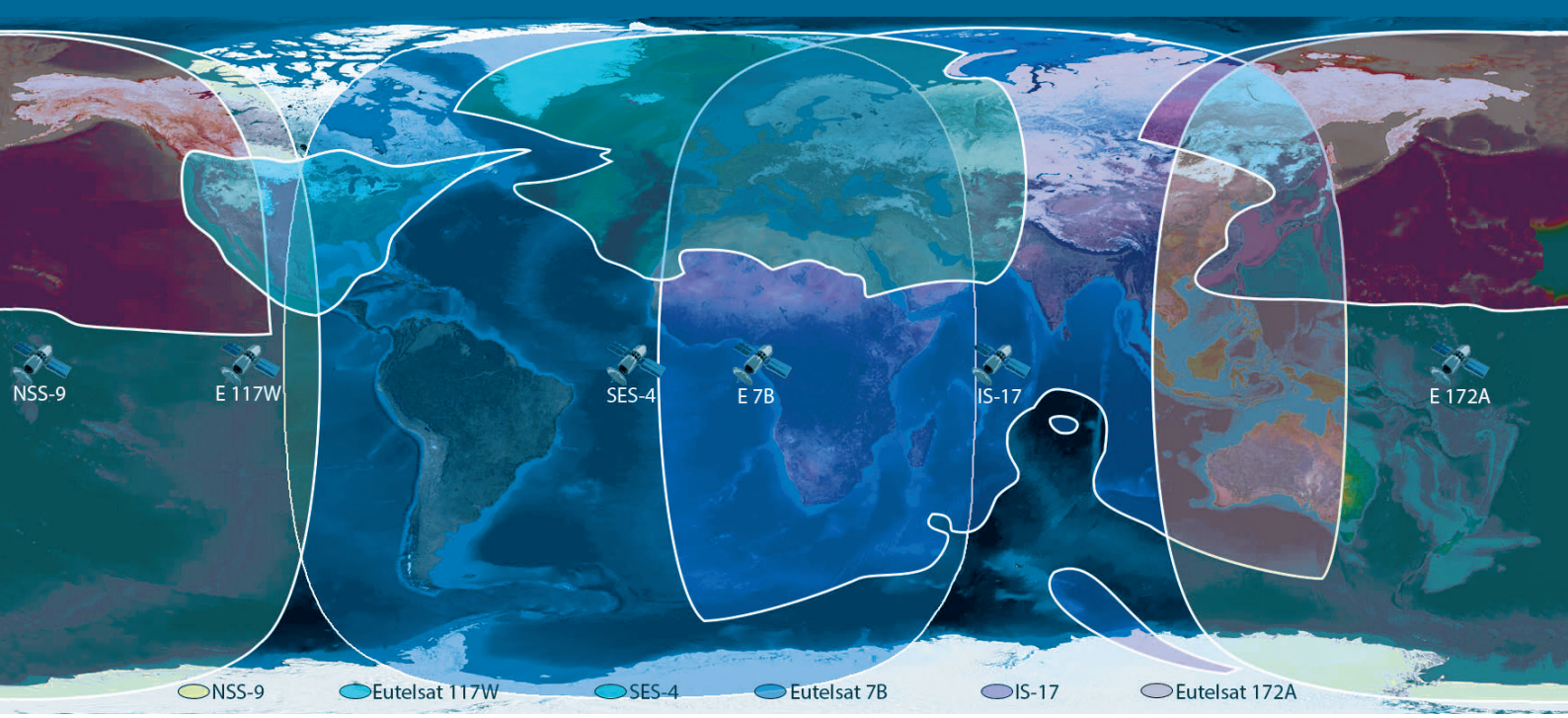
An average of 37 gigabytes of data and products transmitted per day

Competitive bidding conducted for the third generation of the GCI for 2018–2028

Radome construction for auxiliary seismic station AS112, Shemya Island, Alaska (USA).

The Global Communications Infrastructure uses a combination of satellite and terrestrial communication links to enable the exchange of data by IMS facilities and States around the world with the Commission. The GCI first transports raw data from the IMS facilities in near real time to the IDC in Vienna for processing and analysis. It then distributes the analysed data to States Signatories along with reports relevant to verification of compliance with the Treaty. Increasingly, the GCI is also being used as a means for the Commission and station operators to monitor and control IMS stations remotely.

The current, second generation GCI began operation in 2007 under a new contractor. Its satellite communication links are required to operate with 99.5% availability and its terrestrial communication links with 99.95% availability. The GCI is required to send data from transmitter to receiver within seconds. It uses digital signatures and keys to ensure that the transmitted data are authentic and have not been tampered with.



Coverage of the six geostationary satellites of the GCI.

Installation of new GCI equipment at the computer centre in Vienna.

Installation of VSAT equipment at radionuclide station RN24, Isla Santa Cruz, Galápagos Islands (Ecuador).

TECHNOLOGY

IMS facilities, the IDC and States Signatories can exchange data, via their local earth stations fitted with a very small aperture terminal (VSAT), through one of several commercial geostationary satellites. These satellites cover all parts of the world, other than the North and South Poles. The satellites route the transmissions to hubs on the ground, and the data are then sent to the IDC via terrestrial links. Complementing this network, independent subnetworks employ a variety of communications technologies to carry data from IMS facilities to their respective national communications nodes connected to the GCI, from where the data are routed to the IDC.

In situations where VSATs are still not in use or are not operational, a virtual private network (VPN) can provide an alternative means of communication. A VPN uses existing telecommunications networks to transmit data privately. Most of the VPNs for the GCI use the basic public infrastructure of the Internet together with a variety of specialized protocols to support secure encrypted communications. VPNs are also used at some sites to provide a backup communication link in case of failure of a VSAT or terrestrial link. For National Data Centres (NDCs) with a viable Internet infrastructure, a VPN is the recommended medium for receiving data and products from the IDC.

At the end of 2016, the GCI network had connections to 99 States Signatories. These GCI links included 218 VSAT stations (of which 27 have backup VPN links), 38 stand-alone VPN links, 5 independent subnetworks on terrestrial links using multiprotocol label switching (MPLS), a terrestrial MPLS link for US stations located in Antarctica, 2 satellite teleports (in Blåvand, Denmark, and Santa Paula, California, USA) for the geostationary satellites, and a network operations centre (in Maryland, USA). All of these are managed by the GCI contractor. In addition, a total of 71 independent subnetwork links and 6 Antarctic communication links are operated by 10 States Signatories to carry IMS data to a GCI connection point. In total, the combined networks have nearly 340 different communication links to transport data to and from the IDC.

OPERATIONS

The Commission measures the compliance of the GCI contractor against the operational target of 99.5% availability in one year using a rolling 12 month adjusted availability figure. In 2016, this was within ±0.1% of the 99.5% operational target in each month. The rolling 12 month actual availability, which is a measure of the raw uptime of each GCI link over one year, was up to 2.3% lower than the adjusted availability.

Over the year, the traffic transported over the GCI from IMS facilities to the IDC and from the IDC to NDCs averaged 37 gigabytes per day. In addition, data sent to NDCs that are directly connected to the IDC averaged 11.5 gigabytes per day. These figures are the same as the 2015 figures.

A new VSAT link was installed at auxiliary seismic station AS112 (USA) in November 2016. The station started to send data to the IDC in December.

THE INTERNATIONAL DATA CENTRE

HIGHLIGHTS IN 2016

Conduct of a full scale experiment of IDC commissioning

Release of a major update of NDC in a box software

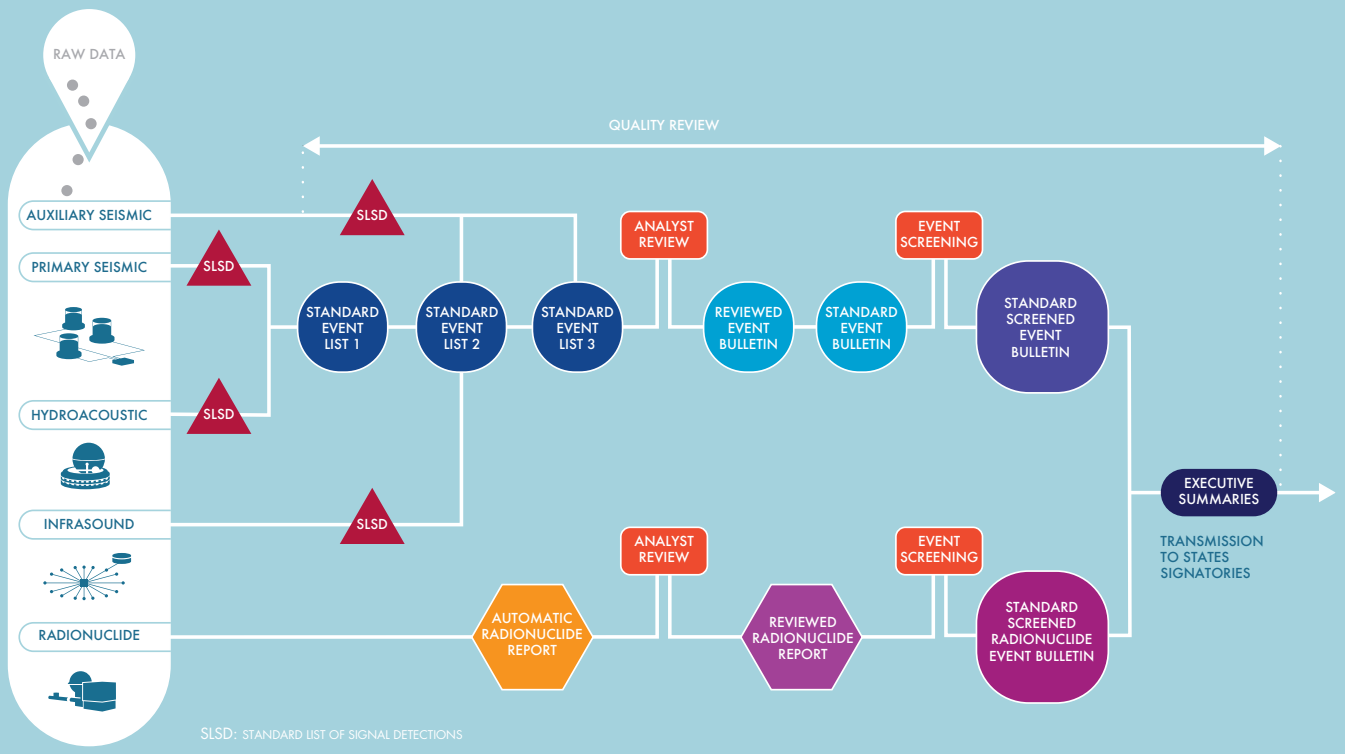
Provision of timely information to States Signatories on the announced nuclear tests by the Democratic People's Republic of Korea

Data analysis at the IDC (Vienna).

The International Data Centre operates the IMS and the GCI. It collects, processes, analyses and reports on the data received from IMS stations and radionuclide laboratories and then makes the data and IDC products available to States Signatories for their assessment. In addition, the IDC provides technical services and support to the States Signatories.

The Commission has created full computer network redundancy at the IDC to ensure a high level of availability of its resources. A mass storage system provides archiving capacity for all verification data, which now cover more than 15 years. Most of the software used in operating the IDC has been developed specifically for the Treaty verification regime.

IDC STANDARD PRODUCTS



OPERATIONS: FROM RAW DATA TO FINAL PRODUCTS

SEISMIC, HYDROACOUSTIC AND INFRASOUND EVENTS

The IDC processes the data collected by the IMS as soon as they reach Vienna. The first data product, known as ● Standard Event List 1 (SEL1), is an automated waveform data report that lists preliminary waveform events recorded by the primary seismic and hydroacoustic stations. It is completed within one hour of the data being recorded at the station.

The IDC issues a more complete waveform event list, ● Standard Event List 2 (SEL2), four hours after first recording the data. SEL2 uses additional data requested from the auxiliary seismic stations along with data from the infrasound stations and any other waveform data that arrive late. After a further two hours have elapsed, the IDC produces the final, improved automated waveform event list, ● Standard Event List 3 (SEL3), which incorporates any additional late arriving waveform data. All of these automated products are produced according to the schedules that will be required when the Treaty enters into force.

IDC analysts subsequently review the waveform events recorded in SEL3 and correct the automated results, adding missed events as appropriate to generate the daily ● Reviewed Event Bulletin (REB). The REB for a given day contains all waveform events that meet the required criteria. During the current provisional operating mode of the IDC, the REB is targeted to be issued within 10 days. After the Treaty enters into force, the REB will be released within 2 days.

RADIONUCLIDE SPECTRA AND ATMOSPHERIC MODELLING

Spectra recorded by particulate and noble gas monitoring systems at IMS radionuclide stations typically arrive several days later than the signals from the same events recorded by the waveform stations. The radionuclide data are automatically processed to produce an ● Automatic Radionuclide Report (ARR) within the schedules required after entry into force of the Treaty. After review by an analyst under the schedules for provisional operation, the IDC issues a ● Reviewed Radionuclide Report (RRR) for each full spectrum received.

The Commission performs daily atmospheric backtracking calculations for each of the IMS radionuclide stations with near real time meteorological data obtained from the European Centre for Medium-Range Weather Forecasts; these are appended to each particulate RRR. Using software developed by the Commission, States Signatories can combine these calculations with radionuclide detection scenarios and nuclide specific parameters to define regions in which sources of radionuclides may be located.

To corroborate the backtracking calculations, the Commission collaborates with the World Meteorological Organization (WMO) through a joint response system. This system enables the Commission to send requests for assistance in the case of suspicious radionuclide detections to 10 Regional Specialized Meteorological Centres or National Meteorological Centres of the WMO located around the world. In response, the centres aim to submit their computations to the Commission within 24 hours.

DISTRIBUTION TO STATES SIGNATORIES

After these data products have been generated, they must be distributed in a timely way to the States Signatories. The IDC provides subscription- and Internet-based access to a variety of products, ranging from near real time data streams to event bulletins and from gamma ray spectra to atmospheric dispersion models.

Data analysis at the IDC Operations Centre (Vienna).

SERVICES

An NDC is an organization in a State Signatory that has technical expertise in the Treaty verification technologies and has been designated by the national authority of the State. Its functions may include receiving data and products from the IDC, processing data from the IMS and elsewhere, and providing technical advice to the national authority.

BUILD-UP AND ENHANCEMENT

IDC COMMISSIONING

The mandate of the IDC is provisional operation and testing of the system in preparation for operation after entry into force. The IDC Progressive Commissioning Plan provides milestones that mark progress in this endeavour and control mechanisms including:

- The Progressive Commissioning Plan itself;
- Draft operational manuals, which set requirements;
- The validation and acceptance test plan;
- A review mechanism, which allows States Signatories to determine if their verification requirements can be met by the system.

Build-up, continuous enhancement, performance monitoring and testing of the IDC are essential to its commissioning. The activities of the Commission in this respect are guided by a framework for monitoring and testing performance that has been developed by the PTS.

During 2016, the PTS conducted a two week, full scale experiment of the analysis capability of the IDC. The experiment used a subset of the tests described in the validation and acceptance test plan as its basis and provided valuable information that will be used in conducting and evaluating future experiments and tests of IDC capabilities in the IDC progressive commissioning process.

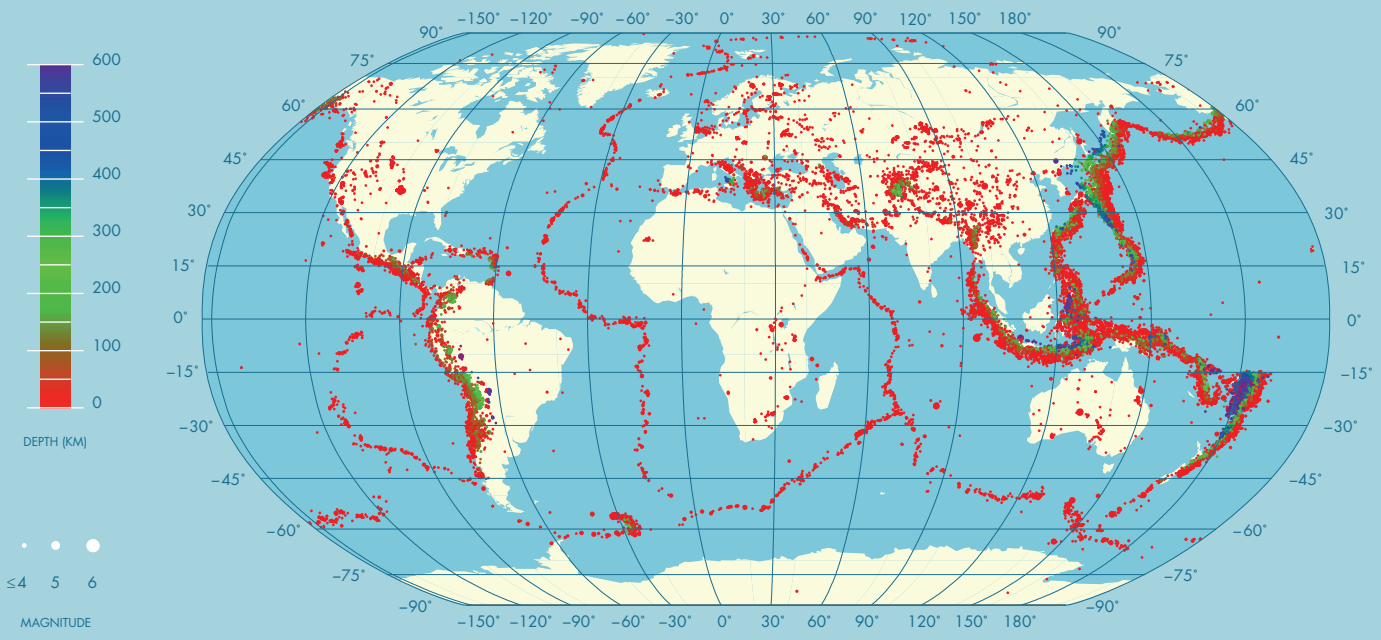
In 2016, the Commission continued drafting the validation and acceptance test plan that will be used in Phase 6 of IDC progressive commissioning. The activities in this area involved technical meetings, interaction on the Experts Communication System (ECS) and discussions during sessions of Working Group B (WGB).

SECURITY IMPROVEMENTS

The Commission continued to identify and address risks to its operational environment and to strengthen security controls on information technology. Measures to safeguard information technology assets included mitigating risks of malware attacks and phased implementation of network access control to prevent unauthorized access to the resources of the Commission.

To ensure an effective information security programme, the Commission continued to roll out its awareness programme to educate PTS staff on best practices in security. The programme focuses on the key tenets of information security: protection of confidentiality, integrity and availability of information assets. The Commission also developed a framework for security policies which serves as a foundation for the phased implementation of best practices.

THE 37 091 EVENTS FROM THE IDC 2016 REVIEWED EVENT BULLETIN



SOFTWARE ENHANCEMENTS

In July 2016, the Commission released a major enhancement to the seismic, hydroacoustic and infrasound components of the NDC in a box software. This new version includes a package for automatic processing of seismic and infrasound data and integrates the IDC seismic detector and a new detector. The new suite of interactive tools made available in this version includes an analysis and review tool for seismo-acoustic data and a tool allowing users to analyse past detections at a station to understand background coherent noise. Enhancements were also made to allow NDCs to integrate IMS data and IDC products with data from local, regional and global networks. These enhancements are supported by new products provided by the Verification Data Messaging System that enable NDC users to retrieve IMS data and products and integrate them into their own processing systems.

The Commission continued to make progress in improving the regional seismic travel time models. It organized training sessions in Egypt and South Africa on NDC in a box to promote increasing the number of ground truth events available in Africa. In turn, the ground truth events will serve as input to improving the seismic travel time models.

The Commission also continued to develop new automatic and interactive software that uses state of the art machine learning and artificial intelligence. The enhanced NET-VISA software is now fully capable for the three waveform technologies and performs better than the existing operational event detection system in terms of both the number of false events it builds and the number of real events detected. Engineering improvements were added to permit processing of any combination of technology, to ensure timeliness of the event bulletins and to better track events from one automatic list to the next.

In October 2016, a new internal system that supports automatic testing of IDC software was released. It allows automatic testing of software modules to ensure that no unwanted behaviour is introduced into the software when a new version is released. Development of automatic test suites covering as much of the functionality of the automatic processing software used at the IDC as possible is ongoing. These test suites are expected to significantly improve the quality of automatic software and to make software testing more reproducible, more efficient and less dependent on human domain experts.

The second phase of IDC re-engineering was launched in 2014 and is expected to be completed in the second quarter of 2017. The project aims to specify a unified architecture for all waveform software, across processing stages, to pave the way for further development and sustainment of the software. The inception phase of the project, which focused on the definition of requirements, was completed in February 2015. The project is currently in the elaboration phase, targeted at system design. Experts from States Signatories reviewed the project deliverables at technical meetings in Vienna in June 2014, June 2015 and February 2016.

Efforts to enhance the IDC software for operational radionuclide processing focused on two areas: increasing the level of consistency between automatic and reviewed categorization of particulate spectra, and reducing the workload of analysts. Important

Training session during the 35th International Geological Congress (South Africa).

enhancements carried out in 2016 included the optimization of key aspects of the radionuclide library and the implementation of a software tool for automatic subtraction of background contribution in particulate samples. The ARR and RRR were also enhanced with relevant information on background subtraction.

As a result of these software enhancements, the IDC exceeded its new target of 60% consistency between the results of automatic and reviewed categorization for 2016. The Commission also continued to explore alternatives to the net count calculations method for beta–gamma analysis currently used in IDC software with a view to integrating such alternatives in future releases.

In 2016, additional steps were taken to replace the current tools that are used by analysts for the interactive review of particulate and noble gas data. An initial version of a new tool to review functionality for beta–gamma coincidence based noble gas data was deployed internally. The tool displays results of new automatic multi-dimensional peak search and peak fitting. Development of this tool is expected to continue through 2017.

Important steps were taken towards increasing the spatial and temporal resolution of the atmospheric transport modelling (ATM) pipeline through enhancements to the core component of the pipeline, the FLEXPART Lagrangian transport and dispersion model.

A new version of the WEB-GRAPE software was released. This version helps users analyse the effect of continuously emitting sources, such as nuclear facilities, on the measured concentrations at monitoring stations. In parallel, work on a project to develop an online version of the WEB-GRAPE software continued. The WEB-GRAPE Internet based service will allow authorized users to post-process and visualize source–receptor sensitivity data generated and stored at the IDC without the need to install commercial software locally.

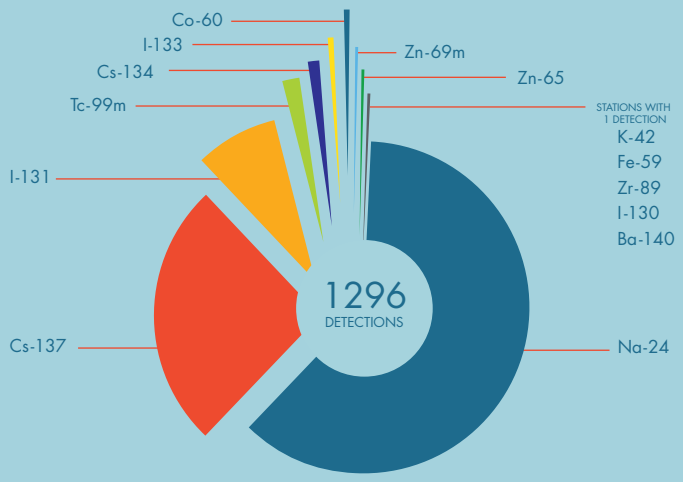
INTERNATIONAL NOBLE GAS EXPERIMENT AND ATMOSPHERIC RADIOXENON BACKGROUND

The 31 noble gas systems that are in provisional operation at IMS radionuclide stations continued to send data to the IDC during 2016. The 25 certified systems sent data to IDC operations, while data from the remaining 6 non-certified systems were processed in the IDC testing environment. The Commission made significant efforts to ensure a high level of data availability for all systems through preventive and corrective maintenance and regular interaction with station operators and system manufacturers.

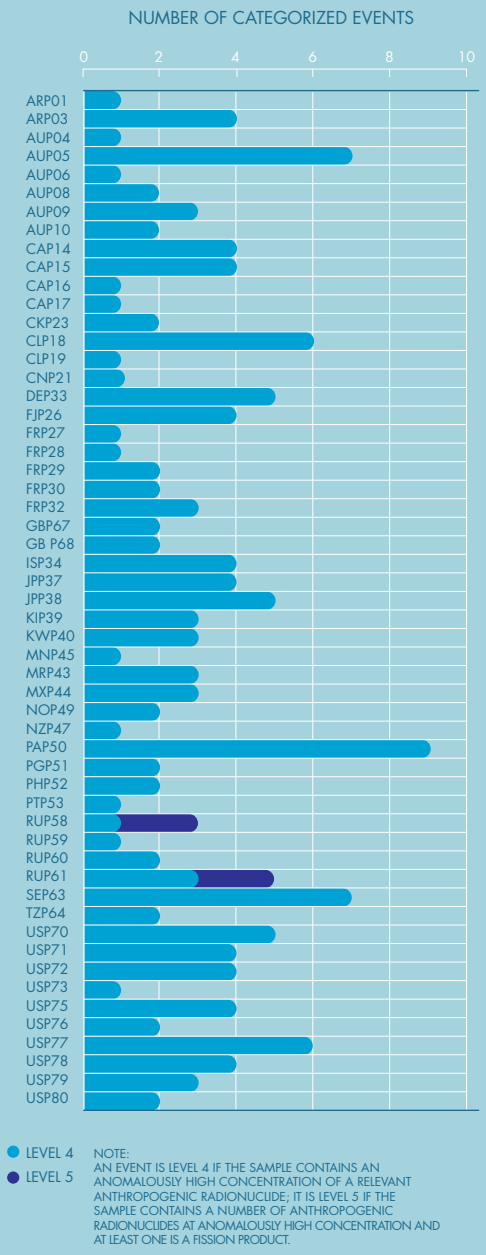
Although the background levels of radioxenon are currently measured at 33 locations as part of the International Noble Gas Experiment, they are still not understood in all cases. A good understanding of the noble gas background is crucial for the identification of signs of a nuclear explosion.

An initiative funded by the EU to improve understanding of the global radioxenon background, which started in December 2008, continued in 2016. The objective of this project is to supplement knowledge on the global radioxenon background over longer periods. By performing measurements for at least 12 months, this project will provide more representative periods at selected sites. This will

TREATY RELEVANT RADIONUCLIDES DETECTED IN 2016

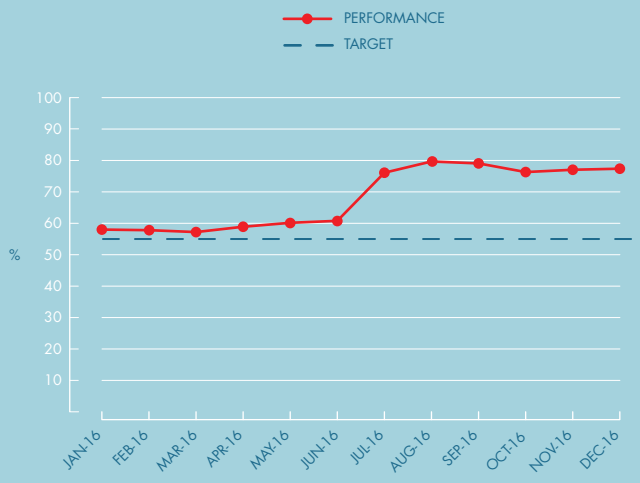


RADIONUCLIDE EVENTS RECORDED BY IMS STATIONS IN IDC OPERATIONS IN 2016



NOTE:
AN EVENT IS LEVEL 4 IF THE SAMPLE CONTAINS AN ANOMALOUSLY HIGH CONCENTRATION OF A RELEVANT ANTHROPOGENIC RADIONUCLIDE; IT IS LEVEL 5 IF THE SAMPLE CONTAINS A NUMBER OF ANTHROPOGENIC RADIONUCLIDES AT ANOMALOUSLY HIGH CONCENTRATION AND AT LEAST ONE IS A FISSION PRODUCT.

CORRECTLY CATEGORIZED AUTOMATICALLY PROCESSED RADIONUCLIDE SPECTRA



provide empirical data for validating network performance, for testing xenon equipment, for data analysis, and for training local experts.

The Commission operated mobile systems in Manado, Indonesia, and in Kuwait City, Kuwait, throughout 2016. After processing and review by the IDC, the data from both campaigns are made available to radionuclide experts for further analysis.

The Commission plans to use the results and conclusions from these campaigns to further develop its noble gas categorization scheme and to gain a better understanding of the inventory, transport and time variation of radioxenon in the atmosphere.

CIVIL AND SCIENTIFIC APPLICATIONS OF THE VERIFICATION REGIME

In November 2006, the Commission agreed to provide continuous IMS data in near real time to recognized tsunami warning organizations. The Commission subsequently entered into agreements or arrangements with a number of tsunami warning centres approved by the United Nations Educational, Scientific and Cultural Organization to provide data for tsunami warning purposes. In 2016, the Commission signed an agreement with the Instituto Português do Mar e da Atmosfera, Portugal. Such agreements or arrangements have now been made with 15 organizations, in Australia, France, Greece, Indonesia, Japan, Malaysia, Myanmar, the Philippines, Portugal, the Republic of Korea, the Russian

Training session during the African Seismological Commission General Assembly (Egypt).

Federation, Thailand, Turkey and the United States of America (Alaska and Hawaii).

IMS infrasound data and IDC products can provide valuable information on a global scale regarding bodies entering the atmosphere. As a consequence of the 2013 meteor airburst in Chelyabinsk, Russian Federation, and the multiple small scale airbursts observed since then, the infrasound technology continued to attract interest beyond the verification regime. The IMS infrasound network continues to observe airbursts that appear in IDC products.

Real time detection of a volcanic eruption can help reduce the hazard to air traffic of ash clouds clogging jet engines. Worldwide eruptions are recorded by IMS infrasound stations and reported in IDC products. It is now established that information obtained by infrasound technology is also useful to the civil aviation community.

The Commission is collaborating with international organizations such as the WMO and the International Civil Aviation Organization, and with the scientific community of the Volcanic Ash Advisory Centres and the Atmospheric dynamics Research InfraStructure in Europe (ARISE) project to develop an infrasound volcanic parameter system. The Commission will continue to serve on the ARISE2 advisory board for the duration of the project (2015–2017).

CTBT: SCIENCE AND TECHNOLOGY CONFERENCES

To keep abreast of scientific developments, the Treaty verification regime relies on the latest advancements in science and technology as well as interaction with the global scientific and technological community. The ongoing interaction allows the Commission to build partnerships with the scientific communities engaged in various aspects of test ban monitoring. Against the backdrop of a dynamic technological landscape, the process is one of collaboration, support and sharing insights. This helps to maintain the relevance of the verification regime by understanding and overcoming challenges. It also means that the verification regime benefits from cutting edge research.

The CTBT: Science and Technology process seeks to track promising relevant innovations from the conferences through development, testing and evaluation and, where appropriate, to incorporate results into the operational systems of the Commission. Examples include the use of cross-correlation methods in the processing of large aftershock sequences; detection and location of events using Bayesian methods applied to seismic, hydroacoustic and infrasound data; improving seismoacoustic velocity models of the earth and atmosphere; and improving uncertainty measures for ATM.

The next CTBT: Science and Technology conference is scheduled for 26–30 June 2017. In 2016, the Commission started substantive preparation for the conference, including the selection of its main themes.

ON-SITE INSPECTION

HIGHLIGHTS IN 2016

Implementation of the new OSI action plan and the third OSI training cycle

Relocation of the ESMF to an interim location and commencement of the project to construct a permanent facility

Regional Introductory Course in South Africa

Nevada Familiarization Activity (USA).

The IMS and IDC monitor the world for evidence of a nuclear explosion. If such evidence were to be detected, the Treaty provides for concerns about possible non-compliance with the Treaty to be addressed through a consultation and clarification process. After the Treaty enters into force, States can also request an OSI, which is the final verification measure under the Treaty.

The purpose of an OSI is to clarify whether a nuclear explosion has been carried out in violation of the Treaty and to gather facts that might assist in identifying any possible violator.

Since an OSI can be invoked by any State Party at any time, the capability to conduct such an inspection requires policies and procedures to be developed and inspection techniques to be validated before the Treaty enters into force. In addition, OSIs require adequately trained personnel, approved core inspection equipment, appropriate logistics and related infrastructure to sustain a team of up to 40 inspectors in the field for a maximum of 130 days while enforcing the highest standards of health, safety and confidentiality.

Over the years, the Commission has continuously strengthened its OSI capabilities through the preparation and development of OSI elements, the conduct of field exercises and the evaluation of its OSI activities. With the conclusion and evaluation of the 2014 Integrated Field Exercise (IFE), the Commission started a new cycle of OSI development. In 2016, it implemented a new action plan for OSI activities in 2016–2019.

Airborne systems field testing at Langenlebarn (Austria).

OSI ACTION PLAN 2016–2019 AND OSI EXERCISE PLAN 2016–2020

Activities during 2016 focused on the finalization, approval and initial implementation of the OSI action plan for 2016–2019 and the OSI exercise plan for 2016–2020, derived from the review and evaluation process of the 2014 IFE. Action plan projects and exercises aim at furthering OSI capabilities towards the establishment of a balanced, coherent and robust verification regime when the Treaty enters into force, within an integrated PTS-wide development, testing, training and exercise framework.

The OSI action plan for 2016–2019 comprises 43 projects categorized into five functional categories: policy development, methodology and documentation; operations and operations support; techniques and equipment development; inspectorate development; and infrastructure development. The PTS will use proven exercise concepts in the OSI exercise plan for 2016–2020, in particular tabletop exercises and field exercises.

The PTS also elaborated detailed project objectives, deliverables, time frames and human and financial resources requirements for 33 projects starting in 2016.

POLICY PLANNING AND OPERATIONS

OSI policy planning and operations efforts in 2016 were closely related to the approval, launch and implementation of the OSI action plan 2016–2019 and the OSI exercise plan 2016–2020, including the overall coordination and the management of 10 individual projects.

Two expert meetings related to OSI policy planning and operations were held in 2016. The first, focusing on ATM in the context of an OSI, was carried out in April. It involved 49 experts from 14 States Signatories, the PTS, as well as representatives from the WMO. The participants discussed ATM capabilities and products for OSI with special emphasis on weather forecasting; the usability of different scales of models (global, regional, local); the availability of data; the required output formats for integration with the OSI information management systems; and the potential roles of the inspection team, the IDC and external providers of ATM for OSI. Recommendations from the meeting will be addressed in the framework of the OSI action plan.

The second expert meeting on field safety and security was also held in

April. The meeting brought together 19 experts from 4 States Signatories, 2 international organizations and the PTS. The participants discussed and assessed lessons from the 2014 IFE in the light of experience gained by other international organizations and PTS Divisions and proposed improvements to the OSI field safety and security concepts. The participants made a number of valuable recommendations that will be considered in the implementation of the relevant OSI action plan projects.

In the area of policy and methodology development, three policy documents on physical security, information security and headquarters support during an OSI were prepared and entered the formal review process. The OSI health and safety policy, inspection team functionality manual and field team functionality standard operating procedure were updated to incorporate the recommendations and lessons from the 2014 IFE. The effects of environmental conditions on OSI operations were investigated in a study with the aim of developing a plan for the testing of equipment and procedures in different environments.

In the area of OSI operations and operations support, the concept of the Operations Support Centre (OSC) at the PTS headquarters was developed and discussed with IDC experts. The hardware system designed to support development and operation of the next generation Integrated Information Management System (IIMS) and field information management system (FIMS) and the prototype OSI databank were installed on the OSC server cluster in the PTS computer centre. A virtual data centre has been commissioned to support multiple operating system environments. The specifications of the IIMS were developed based on the lessons from the 2014 IFE. A prototype application has been created and is under review.

OSI communications equipment underwent maintenance and updating and some of it was used in OSI Division training and testing activities. A complete set of specifications for communications and health and safety equipment was prepared for OSI Workshop-23, which was devoted to the list of equipment for use during OSIs.

EQUIPMENT, PROCEDURES AND SPECIFICATIONS

To further develop OSI equipment and the associated procedures and specifications, 18 projects relating to inspection techniques and capabilities were initiated during 2016 in accordance with the OSI action plan schedule. Preparatory work on projects to be launched in 2017 was also undertaken.

The relocation of the Equipment Storage and Maintenance Facility (ESMF) from Guntramsdorf, Austria, to the temporary storage area in Seibersdorf, Austria, presented significant resource and operational challenges. To mitigate detrimental impacts on the OSI programme, an exchange of letters was concluded between the Commission and the Government of Austria concerning mutual cooperation for training and exercise activities related to OSI. This cooperation was critical during 2016 and allowed the PTS to use the facilities and resources of the Austrian Ministry of Defence and Sports to facilitate the development and testing of OSI techniques, notably in the fields of OSI airborne systems and data transmission in challenging terrain. Given the excellent support and access to resources provided through this mechanism, another exchange of letters for cooperation in 2017 was prepared.

Contributions were made to the General Assembly of the European Geosciences Union and to the "Long Night of Research" exhibition and the "CTBT@20" exhibition, both at the Vienna International Centre (VIC). In addition, the Commission participated in an exhibition on the occasion of a science and technology conference in Cuba; an exhibition on the occasion of 60 years of nuclear explosion monitoring in Washington, D.C.; the Meeting of the Working Group on Verification Technologies and Methodologies of the European Safeguards Research & Development Association in Ispra, Italy; and the American Geophysical Union Fall Meeting in San Francisco.

AIRBORNE TECHNIQUES AND VISUAL OBSERVATION

To enhance the development of OSI airborne techniques and visual observation capabilities, a number of projects were conceived within the framework of the OSI action plan. The implementation of these projects over a period of four years will involve further testing and development of airborne systems and lead to airworthiness certification. Likewise, refinements to ground based visual observation hardware and data collection tools will facilitate the work of inspectors and expedite the dissemination of information within the inspection team.

With respect to ground based visual observation and associated techniques, activities in 2016 focused on two themes: a review of existing hardware in relation to needs and completion of a systems analysis of on-site visual observation tasks to be performed by inspectors. The outcome of these activities will direct the development of a software module that will be tested in 2017 and form part of the next generation IIMS/FIMS.

Configuration and software upgrades as well as procedural amendments were made and tested in 2016 in relation to OSI integrated airborne systems for multispectral including infrared (MSIR) imagery, gamma spectrometry and magnetic field mapping. A field test of PTS-held airborne systems was conducted in September 2016, with equipment installation at an Austrian air force base near Vienna and subsequent flight activities over Lower Austria. To support airborne gamma radiation survey and cross-calibration procedures, a ground based survey was performed including in situ measurements, gamma radiation mapping with portable devices, as well as soil and vegetation sampling for laboratory analyses. The results of this test will inform future airborne gamma survey calibration procedures and provide input for technique specific procedural documents.

To facilitate and simplify in-flight data acquisition and subsequent data processing, customized in-flight gamma radiation survey acquisition software was developed and tested as part of the airborne systems field test. This development is part of a broader attempt to streamline airborne data acquisition and data processing. In this regard, planning was undertaken to test a simplified optical data processing suite for incorporation into operational procedures in 2017.

Significant progress was made in the development of the MSIR system under a project funded by the EU. Under this project, the current airborne MSIR system owned by the PTS will be complemented by two additional sensors that will be fully tested and integrated in 2017.

To support the work of the PTS with respect to airborne gamma spectrometry, two experts provided by Canada as a contribution in kind worked with the PTS to further develop procedures and work instructions on data analysis and reporting. In addition, the Canadian experts and the PTS began planning a field test of airborne gamma spectrometry equipment in winter conditions in Canada in February 2017. PTS staff also attended a practical demonstration of airborne platforms for radiological measurements organized by the United States Department of Energy in Nevada in early 2016.

GEOPHYSICAL INSPECTION TECHNIQUES

Implementation of action plan projects initiated in early 2016 on technology refreshment of the Seismic Aftershock Monitoring System (SAMS), resonance seismometry and active seismic continued on schedule. Preparations were also made for the implementation of two projects in 2017 on non-seismic geophysical techniques for shallow and deep applications.

Concerning SAMS technology refreshment, the PTS, together with the Austrian armed forces, conducted initial field testing of a telemetry system for OSI data transfer, providing the proof of concept for collected SAMS data and demonstrating the broader potential of this system for other OSI techniques and communications. Following testing, the system shall be further developed to expand its usability and application for OSI.

The development of resonance seismometry and active seismic survey techniques in 2016 included field measurements prepared and conducted in cooperation with the University of Helsinki at a mine area in Finland. The activity followed recommendations of an earlier expert meeting on OSI seismic techniques and resulted in continuous measurements involving PTS-held 3-C stations recording seismic noise and signals from a set of chemical explosions. The data also included recordings of other local, regional and teleseismic events, including a strong earthquake in Central Italy. Future efforts will focus on using the data to test various processing methods.

MEASUREMENTS OF RADIOACTIVITY AND RADIONUCLIDE PARTICULATE RELATED INSPECTION TECHNIQUES

The first prototype of a portable spectrometric radiation scanner capable of implementing scenario based simulations of radioactive field contamination was delivered in 2016 and testing is under way. In addition, acceptance tests for three portable high efficiency nuclear measurement devices were conducted and the measurement capacity was enhanced for both in situ and mobile field analysis modules. A graphical user interface for car-borne systems consisting of two measurement systems and specific software is being developed for real time monitoring.

OSI Regional Introductory Course 21, Denel Overberg Test Range (South Africa).

Capabilities for environmental sampling of radionuclide particulates and noble gas were sustained and enhanced through scheduled equipment maintenance and in the context of OSI training activities in 2016. Water sampling equipment was provided by the United States of America for testing and possible integration within an operational configuration for field tests and evaluation.

The transportable 20 foot container that constitutes the heart of the mobile OSI radionuclide field analysis module was installed at the VIC in early 2016. Maintenance was undertaken, and the container was configured to support a design study of the next generation rapid deployment configuration. The current configuration primarily allows for rail, ship and truck transport only. It will be adapted to modular and rapid deployment flight pods to allow for multimodal transportation of equipment via air, land and sea whilst ensuring required functionalities. Detailed technical terms of reference for the next generation rapid deployment configuration of the radionuclide field laboratory were prepared to describe functional requirements, define a scalable modular deployment configuration, and outline the redesign of the current set-up.

NOBLE GAS RELATED INSPECTION TECHNIQUES

The development of the OSI noble gas processing and detection systems MARDS (for argon-37) and XESPM (for xenon) continued in cooperation with the Institute of Nuclear Physics and Chemistry, China Academy of Engineering Physics and with the Northwest Institute of Nuclear Technology of China, respectively. The operational maintenance and upgrades of the SAUNA noble gas system (for xenon) owned by the PTS were implemented as scheduled. Following the relocation of the OSI noble gas field laboratory container that currently houses the SAUNA system to the VIC, basic laboratory support equipment was delivered and maintenance and testing were conducted. These projects, as well as projects on radionuclide data assessment and environmental sampling, are supported by a contract with the University of Bern, Switzerland, on further characterization and development in relation to argon-37 in the environment.

During a three day expert meeting on ATM for OSI organized in Vienna in April, ATM and radionuclide experts discussed the technical aspects and short and long term development plans related to ATM requirements for OSI. An expert meeting on noble gas field sampling was also held in Vienna in June to discuss the status and upcoming technical developments. In addition, an expert meeting on OSI argon-37 phenomenology considered the status and development options to ensure robust and scientifically sound argon-37 field sampling, processing and measurement in the context of an OSI. All three meetings indicated that significant scientific research and engineering is required. This has been reflected in the planning and implementation of the relevant OSI action plan projects.

As part of establishing the global background baseline to provide the context for OSI noble gas data analysis, a standardized sampling procedure for the collection of atmospheric gas samples was drafted. The objective is for States Signatories to voluntarily provide information on natural background concentrations, specifically of the noble gas isotope argon-37. Samples collected to date are measured at a laboratory at the University of Bern.

LOGISTICS AND OPERATIONS SUPPORT

OSI logistics and operations support activities focused on the implementation of OSI action plan projects related to preserving and further developing capabilities for rapid deployment and in-field operations. In addition, support was provided to training, testing and outreach activities carried out by the OSI Division and to PTS-wide efforts to streamline and provide logistics support across the organization.

All projects related to OSI logistics and operations support have been initiated and implemented according to the schedule of the OSI action plan. Advancements in the areas of rapid deployment and auxiliary equipment as well as in security and health and safety continued.

An initial version of the OSI policy on physical security was drafted based on the outcomes of an expert meeting in Vienna in April and is under review by relevant stakeholders. This policy will direct the development of practical arrangements to ensure physical security during an OSI as part of a follow-up project in 2017.

To address identified shortfalls in rapid deployment capabilities, the PTS initiated the design of specialized command post and field laboratory units that can be transported by air. The redesign of cargo nets for the Intermodal Rapid Deployment System containers owned by the PTS and the comprehensive review of dangerous goods transportation practices and materials were also launched. In addition, testing of a specialized rapid deployment air cargo pallet for the transportation of heavy equipment commenced.

Scheduled maintenance, calibration and certification of all major auxiliary OSI equipment components (generator sets, uninterruptible power supplies, etc.) was organized and completed. This included servicing of the OSI base of operations infrastructure as well as the necessary replacement of selected components and spare parts to extend the operational life of current equipment modules. A new high pressure meeting tent and mobile field decontamination kit were also procured for testing and evaluation purposes.

Activities related to OSI logistics and operations support were undertaken in support of other OSI action plan projects and events such as expert meetings, programmatic equipment testing and training (notably the introductory course of the third OSI training cycle) and OSI Workshop-23 on the further development of the OSI equipment list.

TEMPORARY STORAGE AREA AND PTS-WIDE LOGISTICS SUPPORT

In parallel to sustaining and further developing OSI rapid deployment and in-field operations capabilities, a temporary storage area was set up to provide infrastructure and logistics support to OSI programmatic activities. In addition, a testing environment simulating the working and receiving areas of an OSI base of operations was created at the temporary storage area to allow further development and testing of OSI techniques and related data flow processes.

After relocation to the VIC, the containers housing the OSI radionuclide and noble gas field analysis modules were operationalized. The development and testing of related OSI techniques progressed in accordance with the schedule of the relevant OSI action plan projects.

Staff from the OSI Division continued to participate in and contribute substantially to the PTS integrated logistics support project, which aims to optimize and harmonize logistics activities. The OSI Division also continued its work as a core part of the PTS-wide project team for managing the temporary storage area and providing logistics support services, as required, to PTS programmatic activities.

The OSI Division participated in and contributed to scoping and scheduling the establishment of a permanent, designated facility for OSI and other PTS operational functions including storage, maintenance, testing and training. The project management function for the establishment of this permanent facility has been assigned to the OSI Division, and the tendering process for technical project support was successfully concluded at the end of 2016.

OSI DOCUMENTATION

Activities during 2016 involved providing support to WGB, conducting OSI Workshop-23 on the further development of the OSI equipment list, implementation of OSI action plan projects including an expert review of the 2014 IFE progress inspection report and preliminary findings document, and the continuing development and revision of OSI Division QMS documents.

The PTS provided substantive, technical and administrative assistance to WGB during its third round of elaboration of the draft OSI Operational Manual. This included the preparation of a matrix summarizing elements covered in the standard operating procedures (SOPs) and work instructions (WINs) for each OSI technique and guidance on Chapter 6 of the draft OSI Operational Manual.

OSI Workshop-23 was held on 7–11 November 2016 in Baden, Austria. The workshop was attended by 73 participants from all geographical regions, representing 24 States Signatories and the PTS. Considerable preparation and planning went into this particular workshop. As part of the continuing effort to build up OSI operational capability following the 2014 IFE, the workshop focused on the draft list of equipment for use during OSIs and drew on lessons from the 2014 IFE to further develop the OSI equipment list.

Workshop-23 included intensive and in-depth discussions in expert groups organized according to technique: MSIR imaging, radionuclide and noble gas, geophysical techniques and cross-cutting activities including communications and data management. The participants also discussed general topics, such as the structure and content of the OSI equipment list, software issues, documentation and procedures, in plenary sessions. A number of equipment specifications and operational requirements were updated and useful findings as well as recommendations were generated.

Implementation of the OSI action plan projects related to the QMS commenced. A review of the QMS document control and guidance procedures of the OSI Division was conducted. The review drew on lessons learned from the 2014 IFE, the report of OSI Workshop-22 and the expert meeting on the QMS documents of the OSI Division. This process included review and revision of the SOP on the development of OSI QMS documents and the WIN on the rolling list of OSI QMS documents, and the development of QMS documents in the OSI libraries (e-library, e-library replica in the IIMS, OSC library and field library).

The transition to the QMS document management system for the review and approval of newly developed or revised OSI Division QMS documents was finalized.

Efforts were made to coordinate the development or revision of OSI Division QMS documents on prioritized topics, including headquarters support for OSIs, health, safety and security, and the planning, management and support of OSI training and field exercises.

As a part of the OSI action plan project on OSI reporting, the review of the progress inspection report and the preliminary findings document commenced on 1 August 2016. A detailed guidance document was prepared together with the directed reading lists for the review of the two documents. Seven expert reviewers provided comments on the document structure, technical content and consistency with Treaty requirements. The review also addressed OSI techniques ranging from position finding to geophysical techniques that were implemented during the 2014 IFE as well as cross-cutting elements. These comments are currently being compiled and analysed.

The need for technical improvements to the OSI e-library was identified during the 2014 IFE. The PTS continued to implement these improvements during 2016, with a focus on expanding and enhancing the functionality of the e-library at headquarters and in the field.

TRAINING

NEVADA FAMILIARIZATION ACTIVITY

The Nevada Familiarization Activity was held in Las Vegas, Nevada, and at the Nevada National Security Site in the United States of America on 16–20 May 2016. The objectives of the activity were to acquaint OSI surrogate inspectors and national technical experts with observables at legacy nuclear explosive testing sites, to familiarize participants with field experimental operations that have features similar to those of nuclear explosive testing activities and to explore the potential for future Treaty related activities at legacy nuclear explosive testing locations.

A total of 50 participants representing 30 countries from the six geographical regions defined in the Treaty took part in the activity. Participants were selected on the basis of their expertise in visual observation, seismic techniques, geophysics and gamma radiation monitoring as well as their experience as active participants in previous OSI events. The activity was an unprecedented opportunity for OSI surrogate inspectors to learn from, examine and analyse the remnants of legacy nuclear explosive testing. Participants reported that the activity helped to bridge gaps between previous theoretical

Participants in the introductory course for surrogate inspectors (Slovakia).

training and observing and analysing the observables of actual underground nuclear explosions first-hand. The Nevada Familiarization Activity represented a major milestone in OSI surrogate inspector training activities, as it was the first ever to be hosted at the former United States nuclear explosive testing site.

OSI E-TRAINING SYSTEM

Developers of the OSI e-training and simulation system from the All-Russia Research Institute of Automatics visited the PTS in August 2016 to participate in a familiarization session on the prototype of the next generation IIMS/FIMS system with a view toward its integration with the e-training simulation system. The developers presented a preliminary design which allows synthesized data from the e-training simulation system on gravity measurements, magnetic fields and gamma radiation to be visualized in OSI information management tools. Development of the prototype system is ongoing.

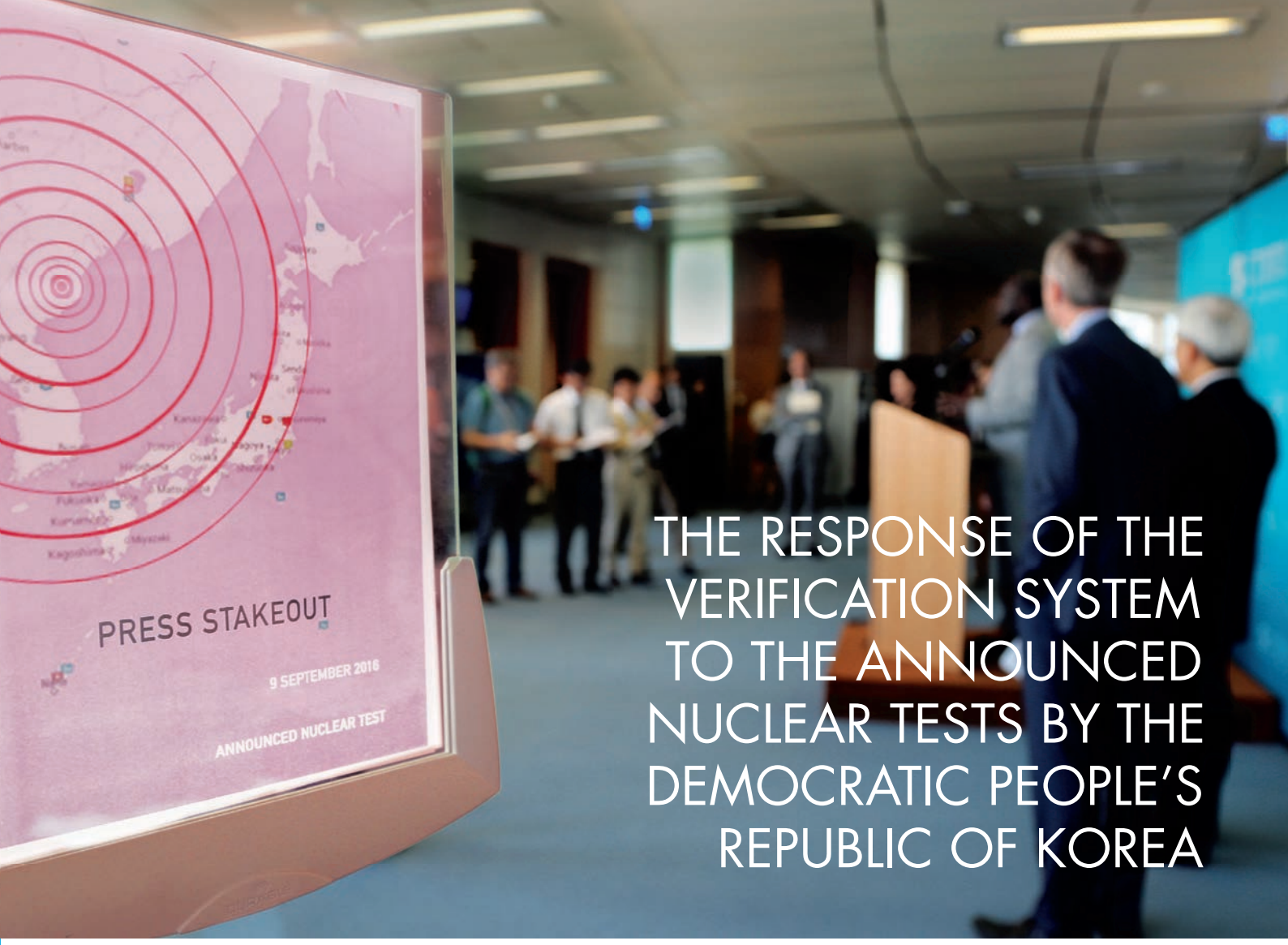
E-LEARNING DEVELOPMENT

Two OSI health and safety e-learning modules were developed to build upon the introductory module. The new modules focus on risk areas during OSI launch and OSC set-up, point of entry arrival and set-up of the base of operations, field work and operations at the base of operations, completion of inspection activities, the OSC and emergency response. These modules are important preparatory resources for the third training cycle for surrogate inspectors and have been added to the e-learning library on the Knowledge and Training Portal. They will also serve as refresher training resources throughout the training cycle.

Technical updates were completed on the IIMS e-learning module to accommodate low bandwidth connections. Initial steps were taken in developing remotely accessible training on the IIMS platform and connecting it to the IIMS e-learning module.

The introductory course for the third training cycle for surrogate inspectors was held in Slovakia on 16–28 October 2016 in Zvolen and at the Training Centre Lešť. A total of 74 trainees from 46 States Signatories attended the course.

The purpose of the course was to establish a solid foundation for acquiring the competencies needed to participate in an OSI and operate in the field. It provided basic training on inspection related topics, including the Treaty and its OSI related provisions, OSI processes and procedures and the signatures and observables of an underground nuclear explosion. The participants undertook cross-cutting hands-on training in ground based visual observation, environmental sampling and gamma radiation monitoring. The course also included field practice on the use of basic communications systems, orientation and navigation equipment, and the organization of an inspection team, including managing confidentiality and health, safety and security principles in accordance with OSI procedures.



THE RESPONSE OF THE VERIFICATION SYSTEM TO THE ANNOUNCED NUCLEAR TESTS BY THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Press briefing on 9 September 2016 (Vienna).

Capturing the evidence of nuclear tests and providing timely data and data analysis to States Signatories is at the core of the mission of the CTBTO.

The readiness of the Commission to fulfil this mission was tested twice in 2016, with announced nuclear tests by the Democratic People's Republic of Korea on 6 January and 9 September. Prior to 2016, the Democratic People's Republic of Korea had conducted three nuclear tests, in 2009, 2011 and 2013.

The 2016 tests were nine months apart. This was the shortest interval between two announced tests thus far. In both cases, as in the three previous announced tests, the verification regime of the Treaty performed in a holistic manner. The results demonstrate that the IMS network and IDC capabilities are reaching full maturity for routine operations and are ready for post-entry-into-force conditions.

Session of the Preparatory Commission on 7 January 2016 (Vienna).

ANNOUNCED NUCLEAR TESTS IN 2016

The announced tests were detected by the IMS facilities. The data were shared with States Signatories in near real time. States Signatories received automatic and reviewed products in accordance with the draft IDC Operational Manual. The Standard Screened Event Bulletins were issued within post-entry-into-force time lines.

All automatic standard event lists (SEL1, SEL2 and SEL3) were issued. These provided analysts with a good starting point to further refine automatic solutions.

To report on the 6 January event, the REB used data from 102 seismic stations, ranging in distance from 4 degrees (PS37 (Russian Federation) and PS31 (Republic of Korea)) to 165 degrees (PS1 (Argentina)). Data from 83 of these stations were used to compute the location. The area of the error ellipse was 193 km^2, well within Treaty requirements for an OSI. The body wave magnitude was determined to be 4.82.

The REB for the event on 9 September used data from 108 seismic stations, with PS37 and PS31 the closest stations and PS1 the furthest. Data from 97 stations were used to compute the location. The area of the error ellipse was 152 km^2, well within Treaty requirements for an OSI. The body wave magnitude was determined to be 5.09, the largest of the five announced tests by the Democratic People's Republic of Korea.

Figure 2 shows the stations that detected the event on 9 September as reported in the REB. Figure 3 presents a waveform comparison for the two stations closest to the two test events in 2016.

The events in 2016 were large enough to be detected by a sufficient number of stations for their explosion characteristics to be clearly seen on the basis of the data from the seismic stations alone. Both were classified as having non-earthquake characteristics in the Standard Screened Event Bulletin.

In both cases, atmospheric scientists at the IDC conducted transport calculations using meteorological forecast models from the European Centre for Medium-Range Weather Forecasts to predict when particulate and noble gas emissions from the location determined by the seismic analysis would reach the IMS radionuclide stations. To this date, no correlation has been made between the seismic recording of the two tests and radionuclide observations.

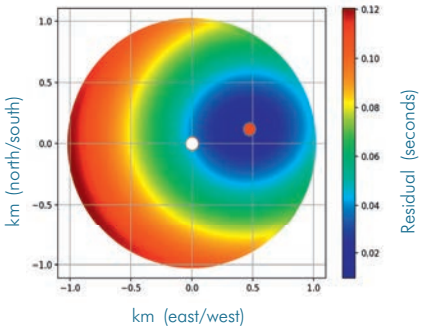


Figure 1. Estimate of the relative distance between the two events in 2016, using the January event (white dot) as a reference for the September event (red dot). The September event is 0.46 km east-north-east of the January event.

The PTS is developing a set of tools for special analysis of selected events. Among these tools is a cross-correlation based technique to refine the REB location relative to a master event. This technique determined that the 9 September event was located 0.46 km to the east and slightly north of the event on 6 January (see Figure 1).

In response to the announced tests, the Commission held technical briefings for States Signatories to discuss the findings of the verification system. The Commission thanked the PTS for its timely response to the events and its technical briefings. It also expressed its satisfaction with the performance of the verification regime of the Treaty.

During the meetings, States Signatories made statements presenting their national positions. States condemned the tests, expressing grave concern over the serious negative effect of such tests on international peace and security and rejecting any and all nuclear explosive tests. They called on the Democratic People's Republic of Korea to refrain from any further nuclear tests and re-emphasized the importance and urgency of the entry into force of the Treaty.

Preparatory Commission meeting on the announced nuclear test on 6 January 2016 (Vienna).

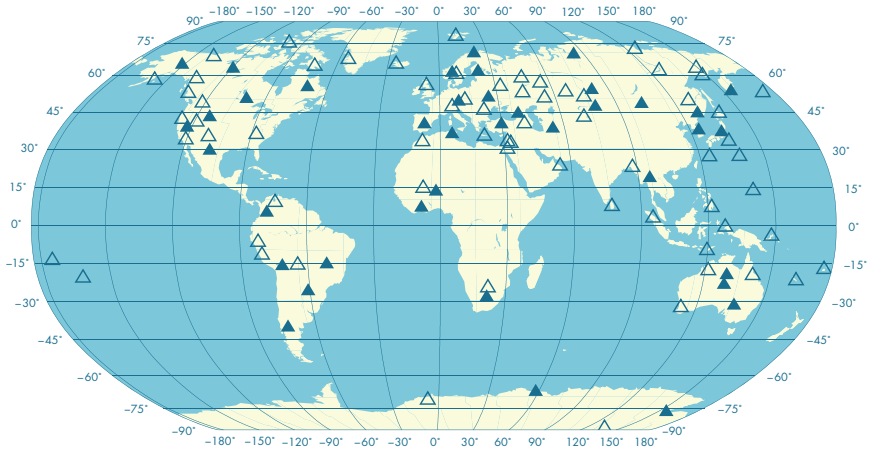


Figure 2. IMS stations that detected the 9 September 2016 event as reported in the REB. Solid triangles represent primary seismic stations; empty triangles represent auxiliary seismic stations.

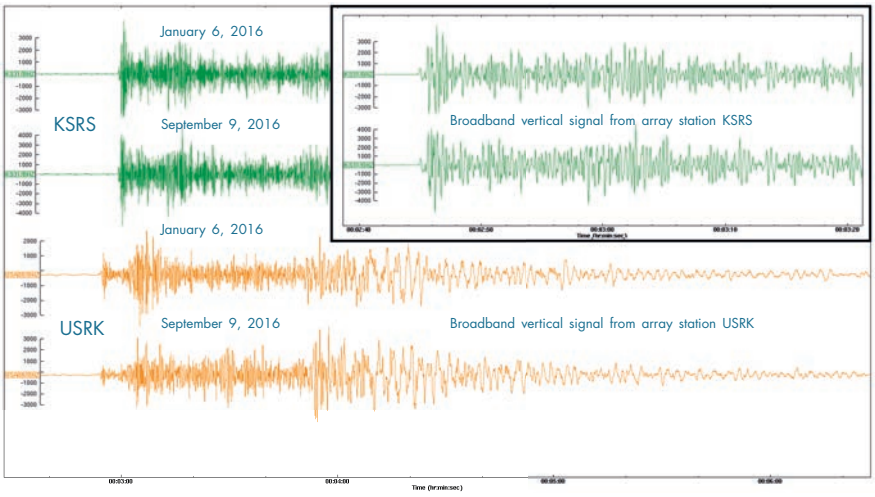


Figure 3. Waveform comparison for the two stations closest to the two test events in 2016. The inset is a detail of a broadband vertical signal.

IMPROVING PERFORMANCE AND EFFICIENCY

HIGHLIGHTS IN 2016

Further development and consolidation of the QMS

Enhancement of the performance reporting tool and refinement of the key performance indicators

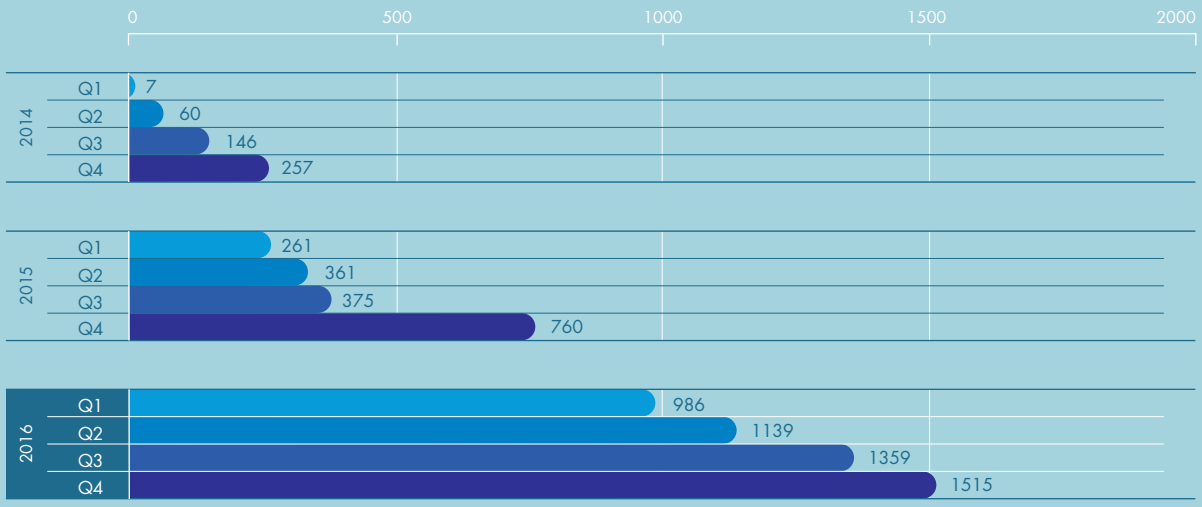
Technical evaluation of IDC Progressive Commissioning

2016 Quality Management Workshop (Vienna).

At all stages of the process of establishing the Treaty verification system, the Commission aims for effectiveness, efficiency, client (i.e.States Signatories and NDCs) orientation and continual improvement through the implementation of its QMS. The implementation of the QMS is meant to ensure that work to establish the verification regime complies with the requirements of the Treaty, its Protocol and relevant Commission documents.

Establishing the QMS is a continual process towards the fulfilment of the goals and objectives set out in the Quality Policy of the Commission and, in particular, instilling a quality culture in the PTS.

QMS DOCUMENT REPOSITORY 2014–2016



QUALITY MANAGEMENT SYSTEM

To ensure continuous provision of high quality products and services, the Commission pursued further improvement of the QMS in 2016. The QMS is a living system that can be adjusted in line with the emphasis placed by the Commission on the needs of States Signatories and NDCs and on continual improvement.

The procedure for controlling and coding QMS documents was consolidated and a completely new release of the QMS document management system was deployed. This release includes customization to facilitate the distribution of technical documentation to States Signatories through the Database of the Technical Secretariat. Progress was made in promoting the QMS and increasing staff awareness of QMS products. This incorporates a significant increase in the use of the document management system.

The Commission continued its discussions with States Signatories on the consolidation of a glossary of terms related to the QMS. A PTS-wide approach to management and sharing of a common vocabulary is an ongoing activity associated with the development of the QMS.

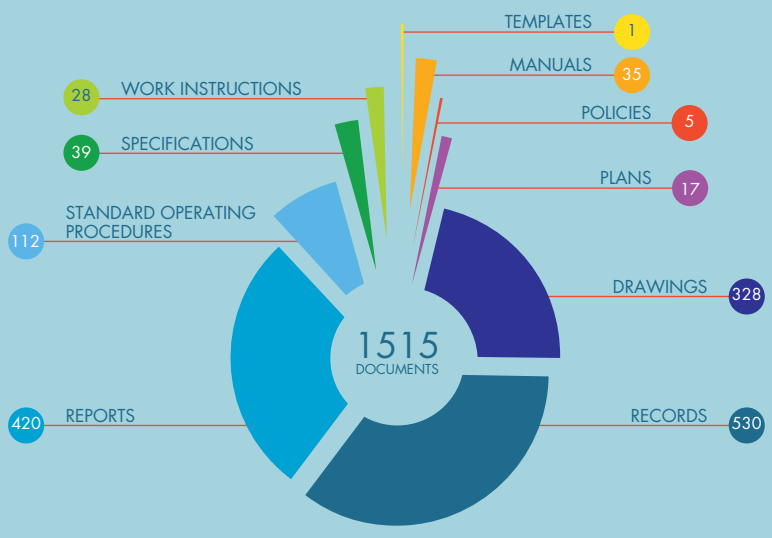
In its Quality Policy, the Commission underlines its focus on client orientation. It therefore continued to prioritize feedback from NDCs, which are the main users of its products and services. The organization encourages NDCs to provide feedback, to relay questions through the established channels and to review the implementation of recommendations during follow-up sessions in workshops.

The PTS provided an updated report on the status of the implementation of recommendations from previous NDC workshops during the 2016 NDC Workshop in Dublin on 9–13 May 2016.

To obtain feedback on the status of QMS implementation, the PTS engaged two international experts to conduct an ad hoc peer review of the QMS. The conclusions and recommendations of the peer review were discussed during the 2016 Quality Management Workshop organized by the PTS.

The 2016 Quality Management Workshop was held in Vienna on 28–30 November 2016. It aimed to review progress and gather feedback on the implementation of the QMS, to improve understanding of the QMS among its users and to ensure that the system is applied and continues to fulfil its purpose. The main topic was a high level review of the progress

NUMBER OF QMS DOCUMENTS BY CATEGORY IN 2016



and status of the QMS as a whole. Discussions included a detailed examination of key elements of the QMS, such as the Quality Policy, the Quality Manual, the verification related Process Maps Manual (key performance indicators), the Process Metrics Manual, performance monitoring tools, the inventory of procedures and the document management system. The workshop also reviewed the PTS performance monitoring and testing framework and the evaluation approach for the progressive commissioning of the verification system. The participation of the Organisation for the Prohibition of Chemical Weapons (OPCW) and the International Atomic Energy Agency (IAEA) enabled participants to share their experience in QMS implementation at their respective organizations. A total of 44 participants from 14 countries, the IAEA, the OPCW and the PTS attended the workshop.

PERFORMANCE MONITORING

The PTS continued its work to improve the performance reporting tool (PRTool). A new version released in 2016 included seven new metrics: one radionuclide particulate product timeliness metric, three noble gas data quality metrics, two waveform data quality metrics and one waveform product timeliness metric. Documentation accompanying the new version includes revisions of the Process Metrics Manual to ensure full consistency between the definitions of the metrics and the reported information.

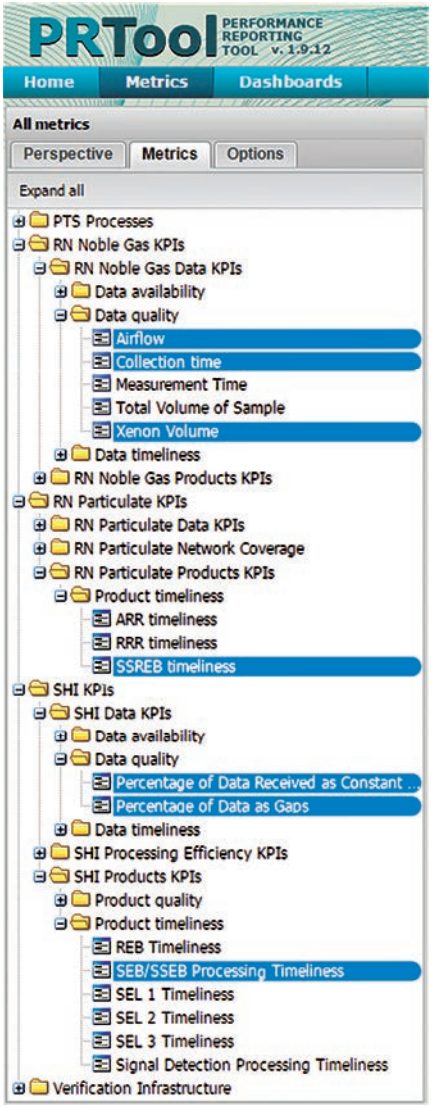
The PTS continued to use PRTool for performance monitoring and assessment of the quality of processes, data and products related to the development and provisional operation of the verification regime.

EVALUATION

In preparation for Full Scale Experiment 1 of the IDC Progressive Commissioning Plan, the PTS updated the draft blueprint that establishes the strategic context of the evaluation to include feedback from the IDC expert meeting in June 2016. The blueprint defines the evaluation requirements and outlines the evaluation methodology. The PTS also developed an evaluation framework to guide the evaluation activities during the experiment, which was conducted on 1–14 September 2016.

Following the completion of the experiment, the PTS analysed the information collected and drafted the report on the technical evaluation.

In the fourth quarter of 2016, the Commission, jointly with the IAEA, the United Nations Industrial Development Organization and the United Nations Office on Drugs and Crime, held a coordination meeting as part of preparations for the annual United Nations Evaluation Group Evaluation Week to be held in Vienna on 15–19 May 2017. The event will provide a unique forum for members of the group to exchange information about recent activities, best practices and lessons learned.



Seven new metrics in the new version of PRTool released in 2016.

2016 Quality Management Workshop (Vienna).

INTEGRATED CAPACITY BUILDING

HIGHLIGHTS IN 2016

Continued focus on capacity building activities

Integration of NDC capacity building with policy and educational outreach activities

Further development of e-learning

Data analysis demonstration at the IDC (Vienna).

The Commission offers States Signatories training courses and workshops on technologies associated with the three pillars of the verification regime – the IMS, the IDC and OSI – as well as on political, diplomatic and legal aspects of the Treaty. These courses help to strengthen national scientific and decision making capabilities in relevant areas to assist in developing capacities in States Signatories to effectively confront the political, legal, technical and scientific challenges facing the Treaty and its verification regime.

In some cases, the Commission provides equipment to NDCs to increase their capacity to participate actively in the verification regime by accessing and analysing IMS data and IDC products. There is a need to update the knowledge and experience of national experts as technologies expand and improve.

By enhancing the technical capabilities of States Signatories, these activities empower all stakeholders to participate in the implementation of the Treaty and to enjoy the civil and scientific benefits of its verification regime.

Training courses are held at the Commission headquarters in Vienna and at other locations, often with the assistance of hosting States. The capacity building programme is funded through the Regular Budget of the Commission and through voluntary contributions. All training activities have a well defined target group, offer detailed content, and are complemented by the educational platform and other outreach activities to the broader scientific community and civil society.

"Science and Diplomacy for Peace and Security: the CTBT@20" (Vienna).

CAPACITY BUILDING ACTIVITIES

As part of its integrated capacity building approach, the Commission continued to expand its education and outreach activities in 2016.

The activities included 6 NDC training courses, 11 station operator training courses, 13 technology workshops and technical meetings, 2 NDC workshops, 7 donations of capacity building systems, 11 installations of capacity building systems, the development of a policy to support capacity building systems (maintenance) and continued development of the extended NDC in a box software package. Services also included responses to queries from States Signatories and members of the accredited CTBTO community in general.

The symposium "Science and Diplomacy for Peace and Security: the CTBT@20" was held from 25 January to 4 February 2016 and served as the first in a series of events in the year of the 20th anniversary of the Treaty. The symposium comprised online e-learning modules and a two week seminar-style symposium in Vienna that was also live-streamed online.

Topics included nuclear testing and the arms race, the role of the Treaty in the nuclear non-proliferation regime, and multilateral arms control and verification. The symposium concluded with a simulation of a future CTBTO Executive Council deliberation on an OSI request, which enabled the participants to apply concepts covered during the symposium.

Approximately 650 participants from all of the geographical regions of the Treaty took part in the symposium in person or online. Participants included Vienna based diplomats, representatives of other international organizations, NDC staff, station operators, academics and representatives of civil society and the media. Almost all of the non-ratifying and non-signatory Annex 2 States were represented at the symposium.

A national seminar to facilitate the completion of the Treaty ratification process by the Government of Myanmar took place in Myanmar on 6–7 July 2016. The Minister of State for Foreign Affairs opened the seminar.

The Commission hosted an activity of the United Nations Programme of Fellowship on Disarmament in September 2016, including a series of presentations on the verification regime and an OSI tabletop exercise.

On 27–28 October 2016, approximately 40 scientists from China, India, Norway, Pakistan, the United States of America and the PTS convened in Beijing for the Second Scientist-to-Scientist Workshop. The workshop provided a platform for substantive technical discussions between scientists from Annex 2 States while also developing capacity in technical areas of Treaty verification. It aimed to build relationships between scientists who are involved in fields related to nuclear test monitoring in the remaining Annex 2 States and to discuss the capabilities of the verification regime.

The Infrasound Technology Workshop 2016 was held in Ecuador on 7–11 November 2016. It attracted 84 participants from 28 countries and served as an international forum for presenting and discussing advancements in infrasound research.

The Commission also promoted online education and training material on the Treaty through its iTunes U site, which currently has 17 collections, including 4 seminar courses with more than 415 free, shareable files. By the end of 2016, the site had more than

2750 subscribers, with more than 16 000 visitors and nearly 20 000 downloads of content.

OSI REGIONAL INTRODUCTORY COURSE

OSI Regional Introductory Course 21 was held on 10–17 April 2016 at the Denel Overberg Test Range near Arniston, Western Cape, South Africa. It was hosted by the Council for Geosciences and the South African Council for the Non-Proliferation of Weapons of Mass Destruction. The course was designed to familiarize trainees with the Treaty and its OSI related provisions and to provide an overview of OSI activities and equipment and hands-on training. The programme featured a two day field training exercise, which offered participants the opportunity to apply their newly acquired expertise in a practical and integrated manner. The field exercise also highlighted the tasks carried out by a field team during an OSI mission and the potential challenges.

A total of 73 trainees from 33 States Signatories in the broader Africa region participated in the course. The trainees represented government ministries and national technical and scientific institutions such as seismological observatories, nuclear energy commissions, research bodies and academia. In addition, facilitators from Austria, Iraq and Israel as well as OSI experts from the PTS participated.

PARTICIPATION OF EXPERTS FROM DEVELOPING COUNTRIES

The Commission continued to implement a project, initiated in 2007, to facilitate the participation of experts from developing countries in its official technical meetings. The aims of this project are to strengthen the universal character of the Commission and to build capacity in developing countries. In November 2015, the Commission extended the project for three years (2016–2018), subject to the availability of sufficient voluntary contributions. The latest detailed annual report on the status of implementation of the project was issued in November 2016.

In 2016, the project supported the participation of experts from 11 States: Albania, Argentina, Ecuador, Jordan, Kyrgyzstan, Madagascar, Myanmar, Nepal, Niger, the Sudan and Viet Nam. These experts took part in the Forty-Sixth and Forty-Seventh Sessions of WGB, including formal meetings and meetings of the expert groups. In addition, the experts benefited from technical discussions with the PTS on key verification related issues.

Since its inception in 2007, the project has supported 36 experts from 32 States, including 10 women. Ten of these States are or were least developed countries. The participants came from 9 States in Africa (Algeria, Burkina Faso, Ethiopia, Kenya, Madagascar, Niger, South Africa, the Sudan, Tunisia), 1 in Eastern Europe (Albania), 8 in Latin America and the Caribbean (Argentina, Bolivia, Brazil, the Dominican Republic, Ecuador, Mexico, Paraguay, Peru), 5 in the Middle East and South Asia (Kyrgyzstan, Jordan, Nepal, Sri Lanka, Yemen), and 9 in South East Asia, the Pacific and the Far East (Indonesia, Mongolia, Myanmar, Papua New Guinea, the Philippines, Samoa, Thailand, Vanuatu and Viet Nam).

Voluntary contributions from China, Norway, Turkey and the United Kingdom were used to finance the project in 2016, and part of these funds has been carried over to 2017. The Commission continues to seek additional voluntary contributions to ensure the financial sustainability of the project.

OSI Regional Introductory Course (South Africa).

TWENTIETH ANNIVERSARY OF THE TREATY

HIGHLIGHTS IN 2016

Symposium "Science and Diplomacy for Peace and Security: the CTBT@20"

Ministerial events in Vienna in June

"Art for a Nuclear Test Ban" initiative

On 24 September 1996, the Comprehensive Nuclear-Test-Ban Treaty opened for signature at the United Nations in New York. Within 24 hours, 71 countries had signed the Treaty, including all five nuclear weapon States.

This important step towards a world free of nuclear weapons followed decades of intense political negotiations as well as diligent scientific groundwork to establish not only the legal parameters of a global ban on nuclear tests, but also a robust independent and internationally controlled verification system.

Ministerial Meeting commemorating 20 years of the Treaty (Vienna).

UNFINISHED BUSINESS

Twenty years later, the CTBT is still not in force. Ratifications by eight remaining Annex 2 States are still pending, preventing the Treaty from achieving full legal standing. Nevertheless, with the signature and ratification of the Treaty by a significant number of States, a de facto international norm against nuclear testing has been established and a robust verification regime is in place to detect any nuclear test in any environment.

A number of events were launched in 2016 to mark the 20th anniversary of the Treaty and the establishment of the Commission. With nuclear tests by the Democratic People's Republic of Korea in January and in September, the year also reminded the international community of the urgency of advancing the entry into force of the Treaty.

In January, the symposium "Science and Diplomacy for Peace and Security: the CTBT@20" brought together former negotiators of the CTBT; representatives of States, civil society and the media; and the newly launched CTBTO Youth Group. The Youth Group also featured prominently in a panel discussion with United Nations Secretary-General Ban Ki-moon at the VIC in April. At an event in Vienna in December, the Executive Secretary and the United Nations High Representative for Disarmament Affairs engaged with young people in person and online for a discussion on the Treaty.

The official highlight of the anniversary year was a high level Ministerial Meeting in June in Vienna at which States Signatories took stock of achievements, reaffirmed their commitment to the global test ban, reviewed challenges and presented proposals for future action.

In August, events were held in Astana, Kazakhstan; New York, United States of America; and Vienna, Austria, to mark the International Day Against Nuclear Tests and the 25th anniversary of the closure of the Semipalatinsk nuclear test site in Kazakhstan.

The "Art for a Nuclear Test Ban" initiative was featured at several exhibits throughout the year, including during the launch of a dedicated United Nations stamp on 21 September in New York.

In September, the five permanent members of the United Nations Security Council issued a statement pledging to strive for ratification of the Treaty and prompt entry into force.

In a historical moment for the Treaty, the United Nations Security Council met on the eve of the 20th anniversary of the CTBT for a debate on the continuing relevance of the Treaty and the importance of pursuing its entry into force. The United Nation Security Council adopted a resolution on the CTBT (S/RES/2310 (2016)) that was co-sponsored by 42 countries.

The 20th anniversary year also witnessed important advances in the build-up of the verification regime with several new IMS stations being installed or certified. This included the installation of the last remaining hydroacoustic station (HA4, Crozet Islands (France)) as well as the installation of radionuclide station RN24, Isla Santa Cruz, Galápagos, (Ecuador). In December, the first IMS station in China (RN21, Lanzhou) was certified, raising the prospects for further certifications in the country in 2017.

From top:

Round table discussion on the twentieth anniversary of the Treaty (Vienna).

United Nations Secretary-General Ban Ki-moon (Vienna).

CTBTO Youth Group member at the #CTBT20 panel with United Nations Secretary-General Ban Ki-moon (Vienna).

"Science and Diplomacy for Peace and Security: the CTBT@20" (Vienna).

Art exhibition on the 2016 International Day against Nuclear Tests (Vienna).

#CTBT20

OUTREACH

HIGHLIGHTS IN 2016

Increased high level engagement with States

Comprehensive public and media outreach strategy

Establishment of the CTBTO Youth Group

"Science and Diplomacy for Peace and Security: the CTBT@20" (Vienna).

The outreach activities of the Commission aim to encourage the signature and ratification of the Treaty, enhance understanding of its objectives, principles and verification regime and of the functions of the Commission, and promote the civil and scientific applications of the verification technologies. These activities entail interaction with States, international organizations, academic institutions, the media and the general public.

TOWARDS ENTRY INTO FORCE AND UNIVERSALITY OF THE TREATY

The CTBT will enter into force when it is ratified by the 44 States listed in Annex 2 of the Treaty. These are States that formally participated in the final stage of the negotiation of the Treaty in the Conference on Disarmament in 1996 and possessed nuclear power reactors or nuclear research reactors at that time. Eight of the 44 States have not yet ratified.

Nonetheless, the Treaty continued to gather momentum towards entry into force and universalization, with Myanmar and Swaziland becoming the most recent States to ratify the Treaty. In addition, Cuba, a non-signatory State, was granted observer status by the Commission. As of 31 December 2016, 183 States had signed and 166 States had ratified, including 36 Annex 2 States.

Despite the lack of ratifications by the remaining eight Annex 2 States, the Treaty is already widely considered to be an effective instrument of collective security and an important pillar of the nuclear non-proliferation and disarmament regime. Political support for the Treaty, for its urgent entry into force and for the work of the Commission continued to be strong in 2016. This was shown by the emphasis placed on the Treaty at numerous high level events and by many senior governmental officials and non-governmental leaders.

An increasing number of States, key decision makers, international and regional organizations, and representatives of civil society participated in activities aimed at advancing further ratifications of the Treaty, including by the remaining Annex 2 States. The Commission conducted consultations with many of the States that had not yet ratified or signed the Treaty.

GROUP OF EMINENT PERSONS AND CTBTO YOUTH GROUP

The Group of Eminent Persons was established by the Executive Secretary in 2013 to advance entry into force of the Treaty. Its members met on the margins of the Ministerial Meeting on 13–14 June 2016 in Vienna to examine political and technical developments related to the CTBT as well as to identify concrete action and new initiatives that could be explored to accelerate entry into force.

The group adopted the Vienna declaration, underscoring the value of maintaining continuous, real time global nuclear test monitoring to detect,

Launch of the CTBTO Youth Group (Vienna).

identify and locate nuclear test explosions whenever they may occur and declaring its unwavering commitment to pursue all avenues available and utilize all means at its disposal to support and complement international efforts to advance the entry into force of the CTBT. The group delivered a statement at the Ministerial Meeting.

Twenty years after the opening for signature of the CTBT, it is clear that entry into force and implementation will be in the hands of the next generation of leaders and policy makers. Therefore the CTBTO Youth Group was launched at the symposium "Science and Diplomacy for Peace and Security: the CTBT@20", held in Vienna from 25 January to 4 February 2016. Promoting youth engagement in the Treaty and its verification technologies was one of the main objectives of the symposium.

The objectives of the Youth Group are to revitalize the discussion around the CTBT among decision makers, academia, students, expert society and the media; to raise awareness of the importance of the nuclear test ban; to build a basis for knowledge transfer to the younger generation; to involve new technologies in the promotion of the CTBT (social media, digital visualization, interactive means of delivering information); and to place the CTBT on the global agenda.

The group is open to all students and young graduates who are directing their careers to contribute to global peace and security and who wish to actively engage in promoting the CTBT and its verification regime.

INTERACTING WITH STATES

The Commission continued efforts to facilitate the establishment of the verification regime and to promote participation in its work. It also maintained a dialogue with States through bilateral visits in capitals and interactions with Permanent Missions in Berlin, Geneva, New York and Vienna. A major focus of such interactions was on States that host IMS facilities and States that have not yet signed or ratified the Treaty, in particular those listed in Annex 2.

The Executive Secretary increased his proactive engagement at high level with States to promote the Treaty, advance its entry into force and universalization and promote the use of the verification technologies and data products.

The Executive Secretary participated in several bilateral meetings and other high level events at which he met several heads of State and Government. These included President Roch Marc Christian Kaboré of Burkina Faso, Vice-President Jorge Glas of Ecuador

Visit by the Political and Security Committee of the European Council (Vienna).

and Prime Minister Benjamin Netanyahu of Israel.

During his visits and in Vienna, the Executive Secretary also met with several foreign ministers and other ministers of States Signatories and observers. These included the foreign ministers of Argentina, Austria, Bangladesh, the Comoros, Costa Rica, Ecuador, Egypt, France, the Gambia, Germany, the Islamic Republic of Iran, Montenegro, the Republic of Korea, Pakistan, the Russian Federation, Turkmenistan and Ukraine, and the EU High Representative. He also met the Vice-Minister of Foreign Affairs of China; the Minister of Science, Technology and Environment of Cuba; the Minister for Industry, Labour, Trade, Energy and Foreign Affairs of Denmark; the State Minister of Science and Technology of Ethiopia; the Undersecretary for Legal Affairs and Multilateral Relations of Iraq; the State Minister for Foreign Affairs of Japan; the Deputy Prime Minister of Jordan; the Minister of Science of Montenegro; the Minister of Energy, Mines, Water and the Environment of Morocco; the Minister of Higher Education, Scientific Research and Executive Training of Morocco; the Deputy Minister for Foreign Affairs and Cooperation of Morocco; the Vice Minister and Special Representative for Korean Peninsula Peace and Security Affairs of the Republic of Korea; the Minister of Higher Education and Research of Senegal; the Minister of Defence of Slovakia; the Minister of the Environment and Spatial Planning of Slovenia; the Deputy Minister of Foreign Affairs and Investment Promotion of Somalia; the Deputy Minister of Foreign Affairs and International Cooperation of South Sudan; the State Minister at the Ministry of Foreign Affairs of Sudan; and the Secretary of Energy of the United States of America.

In addition, the Executive Secretary met other senior government representatives from the following States Signatories and observers: Australia, Belgium, Colombia, Cuba, Ecuador, Equatorial Guinea, Ethiopia, the EU, Finland, France, Germany, Iraq, Israel, Italy, Kazakhstan, Mauritius, Mexico, Montenegro, Morocco, Norway, Portugal, Qatar, the Russian Federation, Sao Tome and Principe, Slovakia, Slovenia, Spain and the United States of America.

OUTREACH THROUGH THE UNITED NATIONS SYSTEM, REGIONAL ORGANIZATIONS, OTHER CONFERENCES AND SEMINARS

The Commission continued to take advantage of global, regional and subregional conferences and other gatherings to enhance understanding of the Treaty and to advance its entry into force and the build-up of the verification regime. The Commission was represented at meetings of the Conference on Disarmament, the

"Ending Nuclear Tests: Why Should I Care?" (Vienna).

African Union, the IAEA, the North Atlantic Treaty Organization, the United Nations General Assembly and its First Committee, the World Economic Forum, the European Leadership Network and the OPCW, among others. The Executive Secretary also participated in several conferences and seminars organized by leading think tanks.

During these meetings and conferences, the Executive Secretary met with a number of heads and other senior officials of international and regional organizations including the Director-General of the OPCW; the Chair of the African Commission on Nuclear Energy (AFCONE) and the Executive Secretary of AFCONE; the United Nations Secretary-General and the High Representative for Disarmament Affairs of the United Nations.

In January, the Executive Secretary gave the opening keynote address at the symposium "Science and Diplomacy for Peace and Security: the CTBT@20" in Vienna. The Executive Secretary also closed the event with Mr Des Browne, vice-chairman of the Nuclear Threat Initiative and former Secretary of State for Defence of the United Kingdom.

In February, the PTS was represented at the twelfth retreat of the Independent Commission on Multilateralism entitled "Weapons of Mass Destruction, Non-Proliferation and Disarmament", held in Geneva.

The Executive Secretary participated in a panel discussion on the 20th anniversary of the Treaty held at the Vienna Center for Disarmament and Non-Proliferation (VCDNP) in March.

In April, the Executive Secretary hosted the high level event "CTBT@20" in Vienna. United Nations Secretary-General Ban Ki-moon was one of the panellists.

In May, the Executive Secretary was the guest of honour at a luncheon held by the Presidency of the European Union, where Permanent Representatives of EU member states discussed current issues pertaining to the Commission.

In December, the Executive Secretary and the United Nations High Representative for Disarmament Affairs held an interactive dialogue with youth entitled "Ending Nuclear Tests: Why Should I Care", organized by the United Nations Office for Disarmament Affairs in partnership with the Commission, the United Nations Information Service Vienna and VCDNP.

The Executive Secretary also attended several conferences, meetings and seminars, where he gave keynote speeches or participated in panels or discussions on the Treaty. These included the annual conference of the Academic Council on the United Nations System entitled "New Approaches for a Peaceful and More Sustainable World" in Vienna, Austria (January); the "Munich Security Conference" in Munich, Germany (February); the event "The Hunt for Weapons of Mass Destruction: Leveraging New Technology", co-hosted by the United States Department of State, the Center for International Security and Cooperation, the Preventive Defense Project and the Freeman Spogli Institute for International Studies at Stanford University, United States of America (April); the "US–Russian Dialogue on Nuclear Issues", co-organized by the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International Studies at Monterey, United States of America, and the Center for Energy and Security Studies, Moscow, Russian Federation (April); a CTBT workshop organized by the Russian Center for Energy and Security Studies in Moscow, Russian Federation (April); the conference "Creating New Momentum for Nonproliferation and Disarmament in the Middle East/Gulf After the Failed NPT Review Conference (II)", organized by the Peace Research Institute Frankfurt, in Berlin, Germany (May); the twelfth "Annual NATO Conference on Weapons of Mass Destruction Arms Control, Disarmament, and Non-proliferation" in Ljubljana, Slovenia (May); the Summer School on Nuclear Disarmament and Non-Proliferation in Mexico City, Mexico (July); the "Foreign Policy Review Conference" in Windhoek, Namibia (July); the sixth "Tokyo International Conference on African Development" in Nairobi, Kenya (August); the international conference "Building a Nuclear-Weapon-Free World" in Astana, Kazakhstan (August); the eleventh Strategic Forum, entitled "Safeguarding the Future", at Lake Bled, Slovenia (September); the international conference "Emerging Technologies and Global Security: An Agenda for the 21st Century" organized by the PIR Center and the Diplomatic Academy of the Russian Foreign Ministry in Moscow, Russian Federation (September); the fifth "EU Non-Proliferation and Disarmament Conference 2016" in Brussels, Belgium (November); the "Nuclear Policy Talks" forum in Washington, D.C., United States of America (November); the event "Nuclear Explosion Monitoring: 60 Years of Science and Innovation", organized by the United States Departments of State and Energy in Washington, D.C., United States of America (November); and the annual Wilton Park conference "Nuclear Non-Proliferation: Planning for 2020" in the United Kingdom (December).

During these conferences, meetings and seminars, the Executive Secretary met with a number of prominent figures from academia, leading think tanks and other non-governmental entities.

Impressions from the "20 Years/20 Voices" video series.

PUBLIC INFORMATION

During 2016, the public web site and social media outlets of the Commission received an average of more than 400 000 visits per month, representing an increase of about 85% compared to 2015. The web site was updated with 56 highlight articles, 12 press releases and 6 media advisories. The Commission also continued to expand its presence on YouTube, Facebook, Twitter and Flickr.

The 38 videos that were added to the YouTube channel of the Commission attracted approximately 100 000 views, with a total viewing time of more than 211 days. To mark the 20th anniversary, the new YouTube video series "20 Years - 20 Voices" was launched. The Executive Secretary, members of the Group of Eminent Persons, former negotiators of the CTBT and members of the Youth Group, among others, expressed their thoughts on the importance of the entry into force of the Treaty. The Commission also produced a short film on the installation of hydroacoustic station HA4 (Crozet Islands, France), which was widely viewed and broadcast by the United Nations, as well as Reuters TV and *Science* magazine.

The publication *CTBT20 Special* was published for the 20th anniversary Ministerial Meeting in June. It was widely disseminated in print and online throughout the remainder of the year.

A number of exhibits featuring the technical capabilities of the verification regime as well as relevant artwork were organized in 2016, including in Washington, D.C., and at the United Nations headquarters in New York and in Vienna. One of the highlights was the launch in September of a dedicated set of United Nations stamps on the CTBT, featuring works by prominent Chinese artists.

GLOBAL MEDIA COVERAGE

Global media coverage of the Treaty and its verification regime remained high, with more than 1340 articles and citations in online media, an increase of nearly 50% compared with 2015. These included interviews with the Executive Secretary by Al Jazeera, the Associated Press, CNN, France 24, i24NEWS, L'Opinion, Mainichi Shimbun, Nature, Russia Today, Xinhua News Agency and other media outlets.

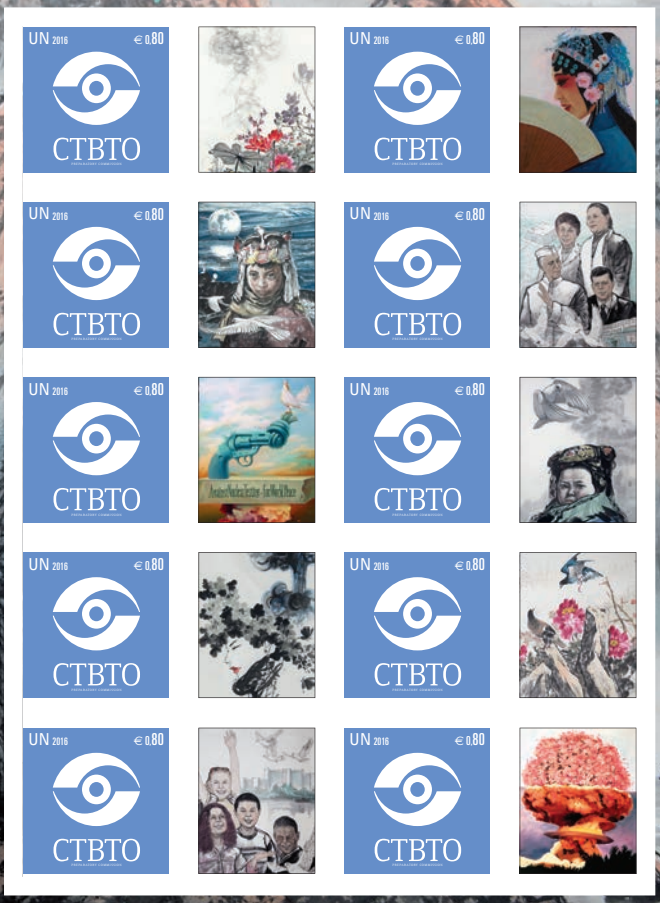
Other significant articles on the Treaty and its verification regime were published by Arms Control Wonk, Bulletin of the Atomic Scientists, DPA, Foreign Policy, Haaretz, The Hindu, In Depth News, the Institute for Security Studies, Inter Press Service, The Japan Times, The Jerusalem Post, New York Daily News, The Olympian, Pakistan Observer, Politico, Reuters, Sputnik, The Times of Israel, The Verge, Wired, The Wire, WNYC radio and Yonhap News Agency.

ART FOR THE NUCLEAR TEST BAN

The "longest sought and hardest fought" international treaty was opened for signature 20 years ago: the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

The Treaty uses modern science to detect and verify nuclear explosions anywhere on the planet and makes our world safer and more secure. Yet the CTBT has still not entered into force.

To mark the anniversary, artists from China have lent their voices and visions to raise awareness on the importance of bringing the Treaty into force.



United Nations stamps on the Treaty, featuring works by Chinese artists.

NATIONAL IMPLEMENTATION MEASURES

Part of the mandate of the Commission is to facilitate the exchange of information between States Signatories on the legal and administrative measures for implementation of the Treaty and, when requested, to give related advice and assistance. Some of these implementation measures will be required when the Treaty enters into force and some may already be necessary during the provisional operation of the IMS and to support activities of the Commission.

In 2016, the Commission continued to promote the exchange of information between States Signatories on national implementation measures. It also delivered presentations on aspects of national implementation at workshops, seminars, training courses, external events and academic lectures.

Art exhibition on the 2016 International Day against Nuclear Tests (Vienna).

PROMOTING THE ENTRY INTO FORCE OF THE TREATY

HIGHLIGHTS IN 2016

Continued strong political support for the Treaty and the work of the Commission

Eighth Ministerial Meeting of the Friends of the CTBT

Adoption of a resolution on the CTBT by the United Nations Security Council

United Nations Security Council, September 2016 (New York).

Every two years, the States that have ratified the Treaty convene a Conference on Facilitating the Entry into Force of the CTBT (also known as an Article XIV conference). In the years between Article XIV conferences, foreign ministers of States Signatories are invited to meet on the margins of the United Nations General Assembly in New York in September. The aim of these Ministerial Meetings is to sustain and increase political momentum and public support for entry into force. To aid this, the ministers adopt and sign a joint statement that is open for adherence by other States. The initiative for these meetings was taken by Japan in cooperation with Australia and the Netherlands, which organized the first Friends of the CTBT Ministerial Meeting in 2002.

The Treaty cannot enter into force until it has been ratified by the 44 States – listed in Annex 2 of the Treaty – that formally participated in the final stage of the negotiation of the Treaty in the Conference on Disarmament in 1996 and possessed nuclear power reactors or nuclear research reactors at that time. Eight of these States have yet to ratify the Treaty, including three that have not signed it.

United Nations Secretary-General Ban Ki-moon at the Ministerial Meeting of the Friends of the CTBT (New York).

NEW YORK, 2016

The eighth Ministerial Meeting of the Friends of the CTBT was held on 21 September 2016 in New York. It was chaired by the Foreign Ministers of Australia, Canada, Finland, Germany, Japan and the Netherlands, in cooperation with the Foreign Minister of Kazakhstan, an Article XIV Co-President. The meeting was attended by the United Nations Secretary-General, as well as a large number of ministers and other senior officials from States Signatories.

The ministers adopted a joint ministerial statement, emphasizing that a nuclear weapon test explosion or any other nuclear explosion would defeat the object and purpose of the CTBT. The statement condemned the nuclear tests conducted by the Democratic People's Republic of Korea and urged all remaining States to sign and ratify the Treaty. It also welcomed advances achieved in ensuring the robustness of the verification regime of the Treaty and its scientific and civil applications.

In his remarks, United Nations Secretary-General Ban Ki-moon recalled that "this year is the twentieth anniversary of the Treaty's opening for signature. But this is not a celebration. It is a stark reminder of the work that remains". He further added that "the Treaty's failure to enter into force was unacceptable when I entered office in 2007". Echoing the wish of the overwhelming majority of States, the Secretary-General urged the remaining States to act without delay and sign and ratify the Treaty as soon as possible.

The 71st session of the United Nations General Assembly provided an additional platform for the expression of support for and renewal of commitment to the Treaty. This was clearly manifested by the adoption of a resolution on the CTBT by the United Nations General Assembly (A/RES/71/86), with 183 States voting in favour. The resolution urged all States that have not yet signed or ratified the Treaty, in particular those whose ratification is needed for its entry into force, to sign and ratify it as soon as possible and underlined the need to maintain momentum towards completion of all elements of the verification regime. The resolution also stressed the vital importance and urgency of the entry into force of the Treaty and noted the contributions of the CTBT Ministerial Meeting, the Article XIV process, the Group of Eminent Persons and the CTBTO Youth Group in promoting the Treaty.

JOINT STATEMENT OF THE PERMANENT MEMBERS OF THE UNITED NATIONS SECURITY COUNCIL

On 15 September 2016, the Governments of China, France, the Russian Federation, the United Kingdom and the United States of America issued a joint statement on the CTBT.

The sponsors of the joint statement pledged to strive for the early ratification and prompt entry into force of the Treaty and urged all States that have not done so to sign and ratify it. They reaffirmed their own moratoria on nuclear weapon test explosions or any other nuclear explosions pending the entry into force of the Treaty and recognized that such a test would defeat the object and purpose of the CTBT. They also called for all States

Signatories to support completion of the verification regime.

UNITED NATIONS SECURITY COUNCIL MEETING ON THE CTBT

The United Nations Security Council held a landmark meeting on the CTBT on 23 September 2016, the eve of the 20th anniversary of its opening for signature.

Members of the Security Council seized the opportunity to express their positions on the Treaty and its entry into force. The significance of the Treaty and appreciation of the work of the Commission were a common theme in almost all statements delivered at the meeting.

Finally, the United Nations Security Council adopted a resolution on the CTBT that was co-sponsored by 42 States (S/RES/2310 (2016)).

The resolution stresses the vital importance and urgency of achieving entry into force of the Treaty and urges all States that have not done so to sign and ratify the Treaty without further delay. It also calls on all States to refrain from conducting any nuclear explosions and to maintain their national moratoria. It emphasizes that such moratoria are an example of responsible international behaviour that contributes to international peace and security. However, the resolution stresses that such moratoria do not have the same permanent, legally binding effect as entry into force of the Treaty.

The resolution underlines the need to maintain momentum towards completion of all elements of the Treaty verification regime and calls upon all States to continue to support and strengthen it. It further states that the verification regime contributes to regional stability as a significant confidence building measure and strengthens the nuclear non-proliferation and disarmament regime.

In its resolution, the United Nations Security Council invited the PTS to provide a report to all States Signatories within 180 days of the adoption of the resolution on the status of States Signatories assessed contributions to the Commission and any additional support provided by States Signatories for the completion of the verification regime and for the maintenance and operational needs for the IDC and IMS.

NEW RATIFICATIONS OF THE TREATY

Myanmar and Swaziland deposited their instruments of ratification on 21 September 2016. The number of ratifications of the Treaty now stands at 166. These new ratifications make the Treaty one of the most adhered to international instruments in the field of disarmament and drive us closer to the desired objective of universality.

United Nations headquarters (New York).

POLICY MAKING

HIGHLIGHTS IN 2016

Holding resumed sessions to address the announced nuclear tests by the Democratic People's Republic of Korea

Appointment of the Vice-Chairpersons of Working Groups A and B

Renewal of the appointment of the Executive Secretary

Live streaming of the Preparatory Commission in January 2016.

The plenary body of the Commission, which is composed of all States Signatories, provides political guidance and oversight to the PTS. The plenary is assisted by two Working Groups.

Working Group A (WGA) deals with budgetary and administrative matters, while WGB considers scientific and technical issues related to the Treaty. Both Working Groups submit proposals and recommendations for consideration and adoption by the plenary meeting of the Commission.

In addition, an Advisory Group of experts serves in a supporting role, advising the Commission through WGA on financial and budgetary matters.

MEETINGS IN 2016

The Commission and its subsidiary bodies each met in two regular sessions in 2016. There was also a joint meeting of WGA and WGB on 1 September and three resumed Sessions of the Commission on 7 January, 22 August and 9 September.

Among the major issues addressed by the Commission during 2016 were the promotion of the Treaty; the 20th anniversary of the Treaty and the Commission; responding to the announced nuclear tests by the Democratic People's Republic of Korea; the decision to allocate the 2014 cash surplus to the establishment of a permanent ESMF, capacity building activities and financing of an Article XIV conference in 2017; and renewal of the appointment of the Executive Secretary for a four year term (2017-2021).

SUPPORTING THE COMMISSION AND ITS SUBSIDIARY BODIES

The PTS is the body that executes the decisions adopted by the Commission. It is multinational in composition: staff are recruited from States Signatories on as wide a geographical basis as possible. The PTS provides substantive and organizational support for the meetings of the Commission and its subsidiary bodies and in the periods between sessions, thus facilitating the decision making process.

With tasks ranging from organizing conference facilities and arranging interpretation and translation to drafting official documents of the various sessions, planning the annual schedule of sessions, and providing substantive and procedural advice to the Chairpersons, the PTS is a vital element in the work of the Commission and its subsidiary bodies.

VIRTUAL WORKING ENVIRONMENT

Through the ECS, the Commission provides a virtual working environment for those who are unable to attend its regular meetings. Using state of the art technology, the ECS records and transmits the proceedings of each official plenary meeting live around the globe. Meetings are then archived for reference purposes. In addition, the ECS distributes supporting documents for each session to States Signatories and alerts participants of new documents by email.

In January 2014, the ECS was integrated into the single sign-on infrastructure of the Commission. Since then, the ECS has become an even more important tool for continuous and inclusive discussion among States Signatories and experts on scientific and technical issues related to the verification regime. In 2016, additional enhancements were introduced to the ECS, making it more user friendly and facilitating access to documents and other meeting related information.

As part of the virtual paper approach, through which the Commission is seeking to limit its output of printed documentation, the PTS continued to provide a 'print on demand' service at all sessions of the Commission and its subsidiary bodies.

INFORMATION SYSTEM ON PROGRESS IN FULFILLING THE MANDATE OF THE TREATY

The Information System with Hyperlinks on Tasks Assigned by the Resolution Establishing the Preparatory Commission monitors progress made in meeting the mandate of the Treaty, the Resolution establishing the Commission and the guidance of the Commission and its subsidiary bodies. It uses hyperlinks to the official documentation of the Commission to provide up to date information on the tasks that remain to be completed in preparing for the establishment of the CTBTO at entry into force and the first session of the Conference of the States Parties. The system is available to all ECS users.

MEETINGS OF THE COMMISSION AND ITS SUBSIDIARY BODIES IN 2016

BODY	SESSION	DATES	CHAIRPERSON
PREPARATORY COMMISSION	RESUMED	7 JANUARY	AMBASSADOR CRISTIAN ISTRATE (ROMANIA)
	FORTY-SIXTH	13–15 JUNE	
	RESUMED	22 AUGUST	
	RESUMED	9 SEPTEMBER	
	FORTY-SEVENTH	7–9 NOVEMBER	
WORKING GROUP A	FORTY-NINTH	30–31 MAY	AMBASSADOR ADNAN OTHMAN (MALAYSIA)
	FIFTIETH	17–19 OCTOBER	
WORKING GROUP B	FORTY-SIXTH	22 FEBRUARY – 4 MARCH	MR JOACHIM SCHULZE (GERMANY)
	FORTY-SEVENTH	22 AUGUST – 2 SEPTEMBER	
	EXTRAORDINARY	9 NOVEMBER	
ADVISORY GROUP	FORTY-SIXTH	3–6 MAY	MR MICHAEL WESTON (UNITED KINGDOM)
	FORTY-SEVENTH	12–14 SEPTEMBER	

HOLDING RESUMED SESSIONS TO ADDRESS THE ANNOUNCED NUCLEAR TESTS BY THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

In response to the announced nuclear tests by the Democratic People's Republic of Korea, the Commission held several informal briefings and two resumed sessions on 7 January and 9 September 2016.

Delegations made statements regarding their national positions on the announced nuclear tests, expressing universal concern about the effect of any such test on international peace and security and rejecting any and all nuclear explosive tests.

RENEWAL OF THE APPOINTMENT OF THE EXECUTIVE SECRETARY

The Commission, acknowledging the commitment and efforts of the Executive Secretary in promoting the Treaty and the work of the Commission, decided by acclamation to renew his appointment for a term of four years to commence on 1 August 2017.

APPOINTMENT OF THE VICE-CHAIRPERSONS OF WORKING GROUPS A AND B

The Commission appointed Ambassador Alfredo Raul Chuquihuara Chil, Permanent Representative of Peru, as the Vice-Chairperson of Working Group A. It also appointed Ms Zeinabou Mindaoudou Souley (Niger) and Mr Sergey Berezin (Kazakhstan) as the Vice-Chairpersons of Working Group B.

The term of office of the Chairpersons and Vice-Chairpersons of the Working Groups is three years.

Sessions of the Policy Making Organs in 2016.

MANAGEMENT

HIGHLIGHTS IN 2016

Acceptance of the statute of the International Civil Service Commission and implementation of the new United Nations compensation package

Provision of additional financial resources for the activities of the Commission through the use of the 2014 cash surplus

Continued efforts to improve geographical and gender representation in the PTS

Annual management retreat.

The PTS ensures effective and efficient management of its activities, including support of the Commission and its subsidiary bodies, mainly through the provision of administrative, financial and legal services.

The PTS also provides a wide variety of general services, from arrangements concerning shipments, customs formalities, visas, identity cards, laissez-passer and low value purchases to insurance, tax, travel and telecommunication services, as well as standard office and information technology support and asset management. Services provided by external entities are continuously monitored to ensure that they are being provided in the most efficient, effective and economical way.

Management also involves coordinating with the other international organizations located in the VIC over planning of office and storage space, maintenance of the premises, common services and security.

Throughout 2016 the Commission continued to focus on smart planning to streamline its activities and to increase synergy and efficiency. It also prioritized results based management.

OVERSIGHT

Internal Audit is an independent and objective internal oversight mechanism. Through the provision of audit, investigation and advisory services, it contributes to the improvement of the risk management, control and governance processes of the PTS.

To ensure its independence and objectivity, Internal Audit reports directly to the Executive Secretary and has direct access to the Chairperson of the Commission. The Chief of Internal Audit also independently submits an annual activity report for consideration by the Commission and its subsidiary bodies.

In 2016, Internal Audit conducted four audits. These audits resulted in the identification of areas for improving efficiency and effectiveness and for strengthening internal controls. Internal Audit also continued to follow up on the implementation of audit recommendations and issued one report on the status of implementation. In addition to its audit work, Internal Audit continued to provide advisory services and acted as coordinator for the External Auditor.

In line with the International Standards for the Professional Practice of Internal Auditing, Internal Audit conducted a review of its charter, which sets out the purpose, authority and responsibilities of the internal audit function.

Internal Audit continued to be actively engaged in forums such as the Representatives of Internal Audit Services of the United Nations Organizations and Multilateral Financial Institutions, whose goal is to share expertise amongst organizations dealing with similar issues.

FINANCE

2016 PROGRAMME AND BUDGET

The Budget for 2016 amounted to US$37 248 800 and €72 317 100, corresponding to slightly less than zero real growth. The Commission uses a split currency system to lessen its exposure to fluctuations in the value of the US dollar against the euro. At the budget exchange rate of €0.796 to $1, the total US dollar equivalent of the 2016 Budget was $128 115 600. This represented a nominal growth of 1.5% but was almost constant in real terms (a decrease of $43 800).

On the basis of the actual average exchange rate in 2016 of €0.9023 to $1, the final total US dollar equivalent of the 2016 Budget was $117 396 312. Of the total Budget, 80% was originally allocated to verification related activities, including $13 958 434 for the Capital Investment Fund (CIF), which is dedicated to the build-up of the IMS, and $8 340 601 for the multiyear funds that are dedicated to other long term verification related projects.

The Budget for 2017 totalled $37 741 400 and €73 509 000, corresponding to slightly less than zero real growth. The Commission uses a split currency system to lessen its exposure to fluctuations in the value of the US dollar against the euro. At the budget exchange rate of €0.796 to $1, the total US dollar equivalent of the 2017 Budget was $130 088 300. This represented a nominal growth of 1.6% but was almost constant in real terms (a decrease of $26 200).

ASSESSED CONTRIBUTIONS

As of 31 December 2016, the collection rates of the assessed contributions from States Signatories for 2016 were 92.5% of the US dollar portion and 91.9% of the euro portion. The number of States that had paid their 2016 assessed contributions in full as of 31 December 2016 was 95.

EXPENDITURE

The expenditure for the Programme and Budget in 2016 amounted to $115 204 282, of which $21 652 882 was from the CIF, $3 551 734 was from the multiyear funds, and the re-mainder from the General Fund. For the General Fund, the unused budget was $7 349 001.

PROCUREMENT

The Commission obligated $62 971 163 through 981 procurements for high value purchases and $780 628 through 652 contractual instruments for low value purchases.

As of 31 December 2016, 140 IMS stations, 12 radionuclide laboratories (including one with new noble gas capability) and 28 noble gas systems were under contract for testing and evaluation or for PCAs.

VOLUNTARY SUPPORT FORUM

The Voluntary Support Forum was initiated in 2014 as a forum for interaction with the donor community and to ensure that voluntary contributions serve the strategic goals of the Commission. The forum attempts to consolidate the efforts to mobilize extrabudgetary funding, to strengthen interaction with donors and to increase transparency and accountability regarding the use of voluntary contributions.

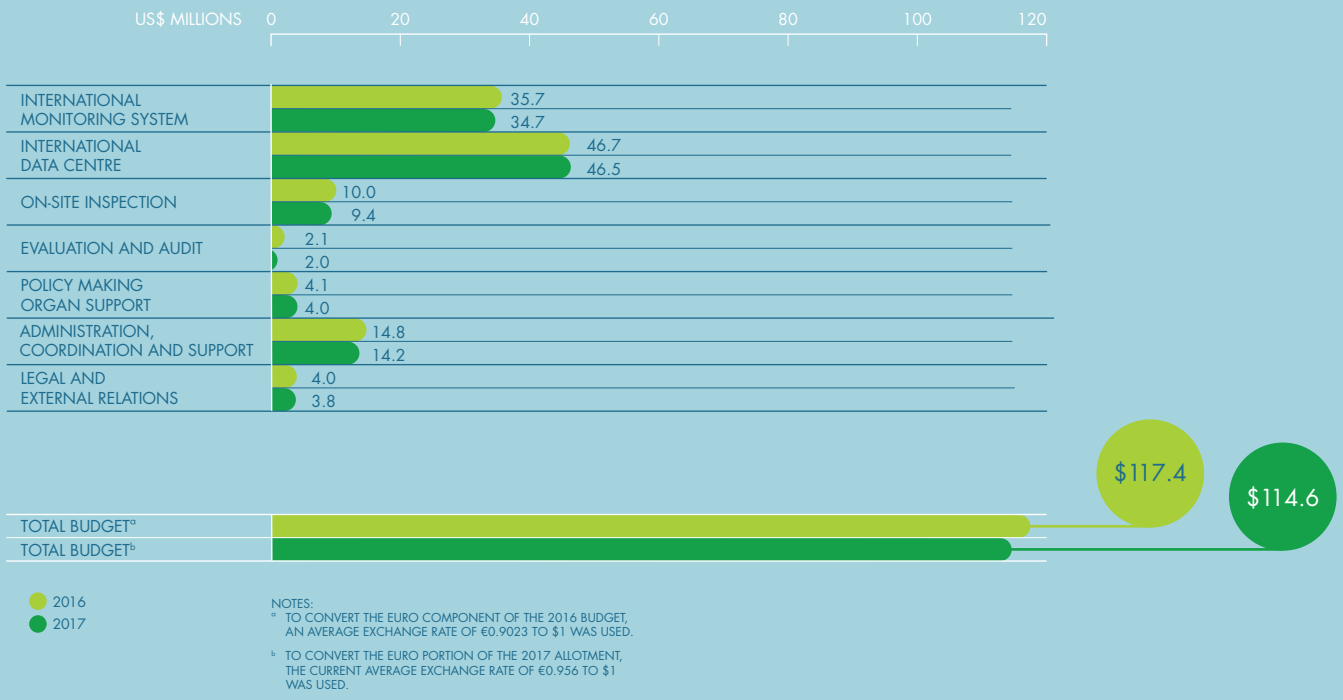
The Voluntary Support Forum held one meeting in 2016. All States Signatories and observers were invited.

During the meeting the PTS presented several projects for which it sought voluntary contributions in 2017. The projects covered areas such as supporting the participation of scientists in the Science and Technology conference in June 2017, the advocacy and other outreach activities of the CTBTO Youth Group, and the technical capacity of States Signatories in OSI and IDC activities. The total amount sought for all projects was approximately $2 million.

HUMAN RESOURCES

The organization secured the human resources for its operations by recruiting and retaining highly competent and

DISTRIBUTION OF THE 2016–2017 BUDGET BY AREA OF ACTIVITY

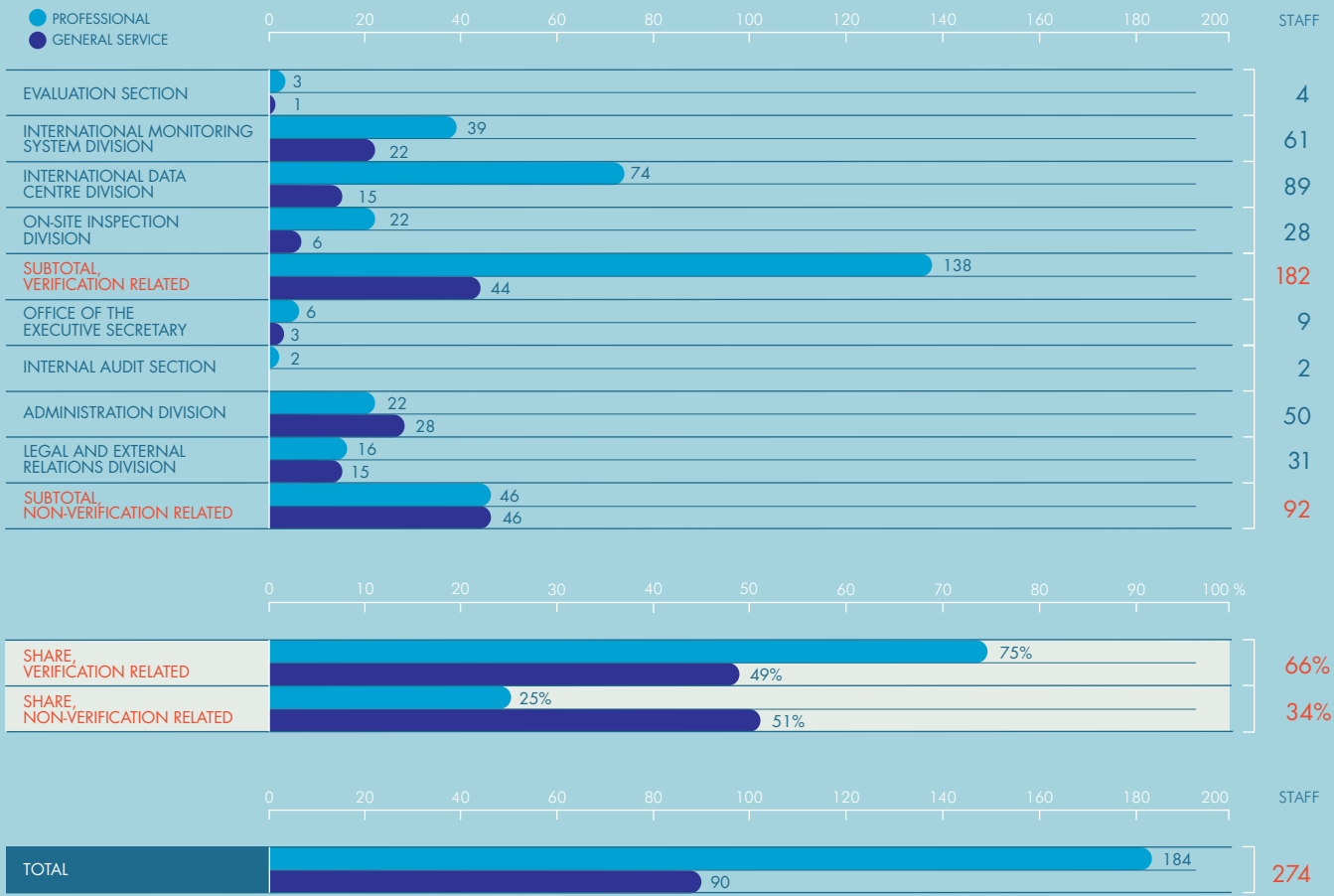


NOTES:

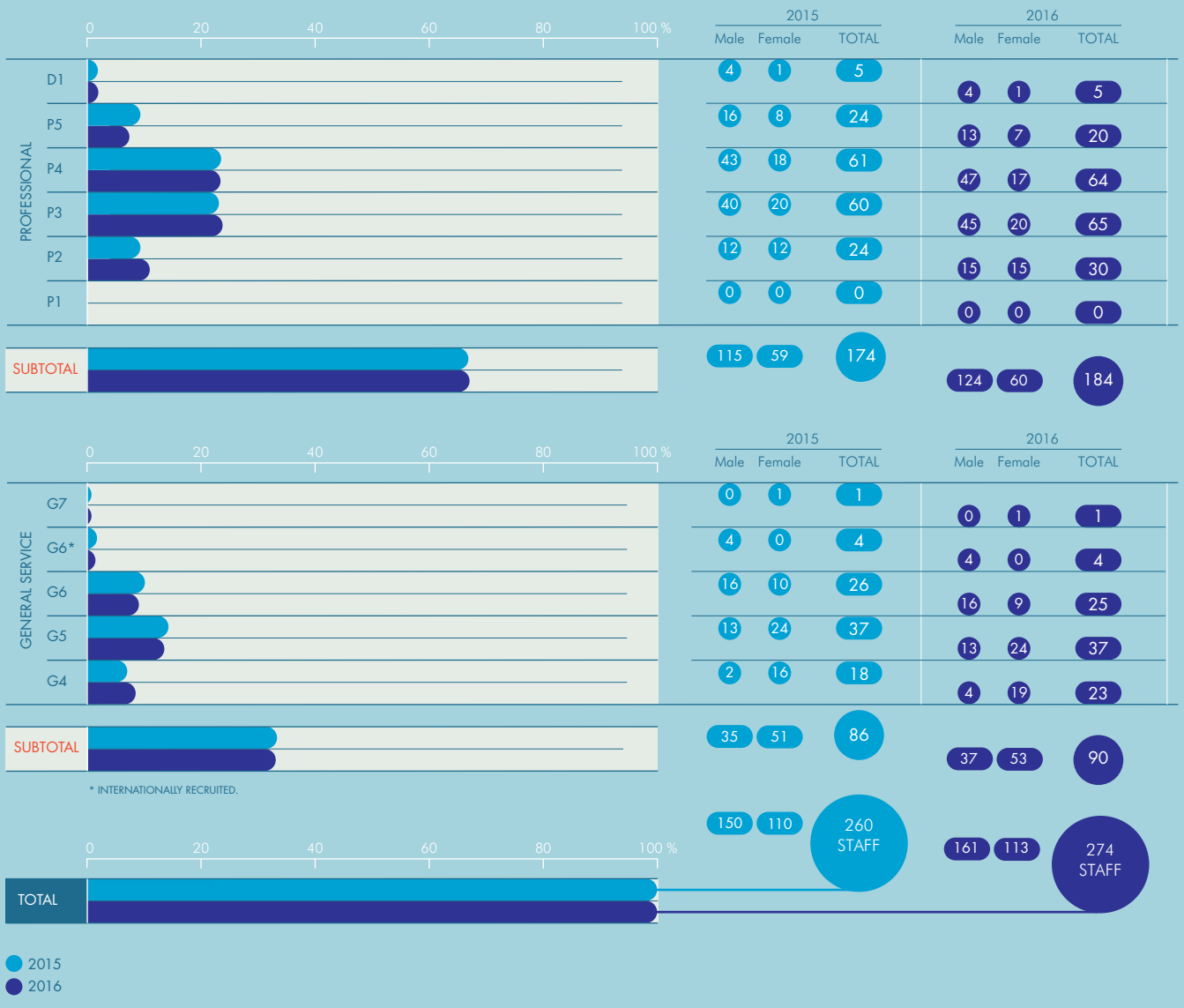
[a] TO CONVERT THE EURO COMPONENT OF THE 2016 BUDGET, AN AVERAGE EXCHANGE RATE OF €0.9023 TO $1 WAS USED.

[b] TO CONVERT THE EURO PORTION OF THE 2017 ALLOTMENT, THE CURRENT AVERAGE EXCHANGE RATE OF €0.956 TO $1 WAS USED.

FIXED TERM STAFF MEMBERS BY FIELD OF WORK AS OF 31 DECEMBER 2016



FIXED TERM STAFF MEMBERS BY GRADE AND GENDER, 2015 AND 2016



* INTERNATIONALLY RECRUITED.

diligent staff. Recruitment was based on obtaining the highest standards of professional expertise, experience, efficiency, competence and integrity. Full attention was paid to the principle of equal employment opportunities, to the importance of recruiting staff on as wide a geographical basis as possible, and to other relevant criteria in the Treaty and the Staff Regulations.

Throughout the year, the PTS continued its efforts to improve human resources policies, procedures and processes.

As of 31 December 2016, there were 274 regular fixed term staff members of the PTS from 82 countries, compared with 259 staff members from 77 countries on 31 December 2015. In 2016, there were 184 staff members in the Professional and higher categories, while in 2015 there were 174.

USE OF THE 2014 CASH SURPLUS FOR THE ACTIVITIES OF THE COMMISSION

During its Forty-Seventh Session, the Commission decided to authorize the PTS to use the 2014 cash surplus in the total amount of approximately $9.8 million for the establishment of a permanent ESMF, for capacity building activities and for financing of an Article XIV conference in 2017.

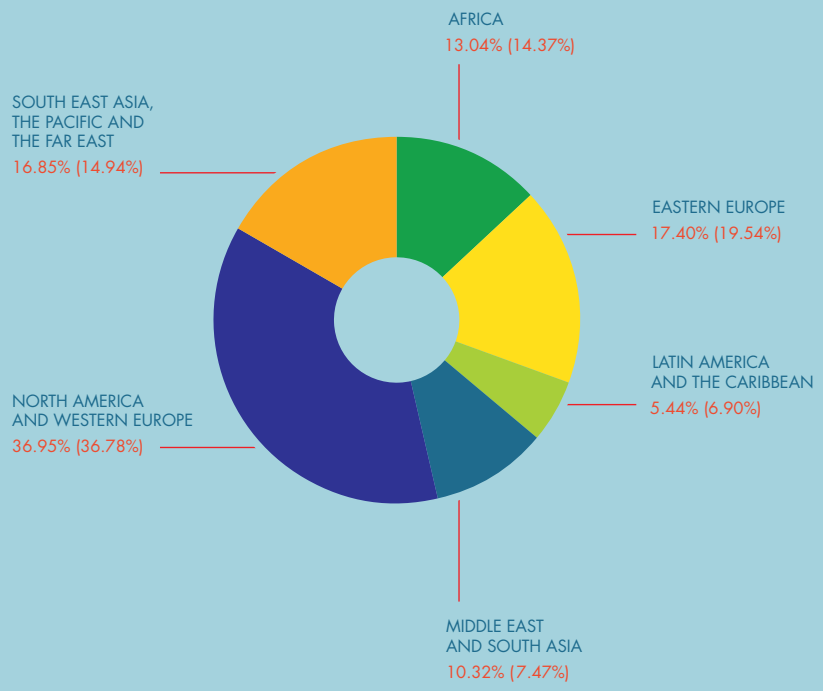
ACCEPTANCE OF THE STATUTE OF THE INTERNATIONAL CIVIL SERVICE COMMISSION AND IMPLEMENTATION OF THE NEW UNITED NATIONS COMPENSATION PACKAGE

At its Forty-Seventh Session, the Commission decided to accept the statute of the International Civil Service Commission and to authorize the PTS to implement the new compensation package approved by the United Nations General Assembly for staff members in the Professional and higher categories.

Above and opposite: annual management retreat.

STAFF MEMBERS IN THE PROFESSIONAL CATEGORY BY GEOGRAPHICAL REGION AS OF 31 DECEMBER 2016

PERCENTAGES AS OF 31 DECEMBER 2015 ARE SHOWN IN BRACKETS



SIGNATURE AND RATIFICATION

STATUS AS OF 31 DECEMBER 2016

183 STATES SIGNATORIES

- 166 RATIFIED
- 17 SIGNED BUT NOT RATIFIED

Ratifications by Swaziland (left) and Myanmar (right) in 2016.

STATES WHOSE RATIFICATION IS REQUIRED FOR THE TREATY TO ENTER INTO FORCE

ANNEX 2

44 STATES

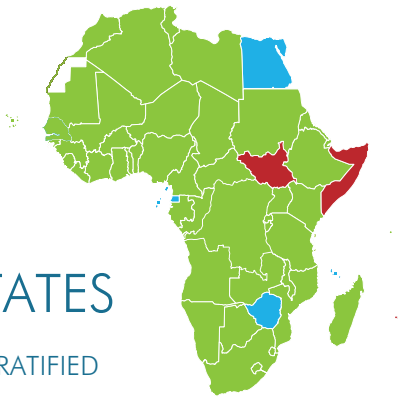
- 36 RATIFIED
- 5 SIGNED BUT NOT RATIFIED
- 3 NOT SIGNED

STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
ALGERIA	15 OCT. 1996	11 JUL. 2003
ARGENTINA	24 SEP. 1996	4 DEC. 1998
AUSTRALIA	24 SEP. 1996	9 JUL. 1998
AUSTRIA	24 SEP. 1996	13 MAR. 1998
BANGLADESH	24 OCT. 1996	8 MAR. 2000
BELGIUM	24 SEP. 1996	29 JUN. 1999
BRAZIL	24 SEP. 1996	24 JUL. 1998
BULGARIA	24 SEP. 1996	29 SEP. 1999
CANADA	24 SEP. 1996	18 DEC. 1998
CHILE	24 SEP. 1996	12 JUL. 2000
CHINA	24 SEP. 1996	
COLOMBIA	24 SEP. 1996	29 JAN. 2008
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA		
DEMOCRATIC REPUBLIC OF THE CONGO	4 OCT. 1996	28 SEP. 2004
EGYPT	14 OCT. 1996	
FINLAND	24 SEP. 1996	15 JAN. 1999
FRANCE	24 SEP. 1996	6 APR. 1998
GERMANY	24 SEP. 1996	20 AUG. 1998
HUNGARY	25 SEP. 1996	13 JUL. 1999
INDIA		
INDONESIA	24 SEP. 1996	6 FEB. 2012

STATE (CONT.)	DATE OF SIGNATURE	DATE OF RATIFICATION
IRAN (ISLAMIC REPUBLIC OF)	24 SEP. 1996	
ISRAEL	25 SEP. 1996	
ITALY	24 SEP. 1996	1 FEB. 1999
JAPAN	24 SEP. 1996	8 JUL. 1997
MEXICO	24 SEP. 1996	5 OCT. 1999
NETHERLANDS	24 SEP. 1996	23 MAR. 1999
NORWAY	24 SEP. 1996	15 JUL. 1999
PAKISTAN		
PERU	25 SEP. 1996	12 NOV. 1997
POLAND	24 SEP. 1996	25 MAY 1999
REPUBLIC OF KOREA	24 SEP. 1996	24 SEP. 1999
ROMANIA	24 SEP. 1996	5 OCT. 1999
RUSSIAN FEDERATION	24 SEP. 1996	30 JUN. 2000
SLOVAKIA	30 SEP. 1996	3 MAR. 1998
SOUTH AFRICA	24 SEP. 1996	30 MAR. 1999
SPAIN	24 SEP. 1996	31 JUL. 1998
SWEDEN	24 SEP. 1996	2 DEC. 1998
SWITZERLAND	24 SEP. 1996	1 OCT. 1999
TURKEY	24 SEP. 1996	16 FEB. 2000
UKRAINE	27 SEP. 1996	23 FEB. 2001
UNITED KINGDOM	24 SEP. 1996	6 APR. 1998
UNITED STATES OF AMERICA	24 SEP. 1996	
VIET NAM	24 SEP. 1996	10 MAR. 2006

SIGNATURE AND RATIFICATION OF THE TREATY BY GEOGRAPHICAL REGION

AFRICA



54 STATES

45 RATIFIED

6 SIGNED BUT NOT RATIFIED

3 NOT SIGNED

STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
ALGERIA	15 OCT. 1996	11 JUL. 2003
ANGOLA	27 SEP. 1996	20 MAR. 2015
BENIN	27 SEP. 1996	6 MAR. 2001
BOTSWANA	16 SEP. 2002	28 OCT. 2002
BURKINA FASO	27 SEP. 1996	17 APR. 2002
BURUNDI	24 SEP. 1996	24 SEP. 2008
CABO VERDE	1 OCT. 1996	1 MAR. 2006
CAMEROON	16 NOV. 2001	6 FEB. 2006
CENTRAL AFRICAN REPUBLIC	19 DEC. 2001	26 MAY 2010
CHAD	8 OCT. 1996	8 FEB. 2013
COMOROS	12 DEC. 1996	
CONGO	11 FEB. 1997	2 SEP. 2014
CÔTE D'IVOIRE	25 SEP. 1996	11 MAR. 2003
DEMOCRATIC REPUBLIC OF THE CONGO	4 OCT. 1996	28 SEP. 2004
DJIBOUTI	21 OCT. 1996	15 JUL. 2005
EGYPT	14 OCT. 1996	
EQUATORIAL GUINEA	9 OCT. 1996	
ERITREA	11 NOV. 2003	11 NOV. 2003
ETHIOPIA	25 SEP. 1996	8 AUG. 2006
GABON	7 OCT. 1996	20 SEP. 2000
GAMBIA	9 APR. 2003	
GHANA	3 OCT. 1996	14 JUN. 2011

STATE (CONT.)	DATE OF SIGNATURE	DATE OF RATIFICATION
GUINEA	3 OCT. 1996	20 SEP. 2011
GUINEA-BISSAU	11 APR. 1997	24 SEP. 2013
KENYA	14 NOV. 1996	30 NOV. 2000
LESOTHO	30 SEP. 1996	14 SEP. 1999
LIBERIA	1 OCT. 1996	17 AUG. 2009
LIBYA	13 NOV. 2001	6 JAN. 2004
MADAGASCAR	9 OCT. 1996	15 SEP. 2005
MALAWI	9 OCT. 1996	21 NOV. 2008
MALI	18 FEB. 1997	4 AUG. 1999
MAURITANIA	24 SEP. 1996	30 APR. 2003
MAURITIUS		
MOROCCO	24 SEP. 1996	17 APR. 2000
MOZAMBIQUE	26 SEP. 1996	4 NOV. 2008
NAMIBIA	24 SEP. 1996	29 JUN. 2001
NIGER	3 OCT. 1996	9 SEP. 2002
NIGERIA	8 SEP. 2000	27 SEP. 2001
RWANDA	30 NOV. 2004	30 NOV. 2004
SAO TOME AND PRINCIPE	26 SEP. 1996	
SENEGAL	26 SEP. 1996	9 JUN. 1999
SEYCHELLES	24 SEP. 1996	13 APR. 2004
SIERRA LEONE	8 SEP. 2000	17 SEP. 2001
SOMALIA		
SOUTH AFRICA	24 SEP. 1996	30 MAR. 1999
SOUTH SUDAN		
SUDAN	10 JUN. 2004	10 JUN. 2004
SWAZILAND	24 SEP. 1996	21 SEP. 2016
TOGO	2 OCT. 1996	2 JUL. 2004
TUNISIA	16 OCT. 1996	23 SEP. 2004
UGANDA	7 NOV. 1996	14 MAR. 2001
UNITED REPUBLIC OF TANZANIA	30 SEP. 2004	30 SEP. 2004
ZAMBIA	3 DEC. 1996	23 FEB. 2006
ZIMBABWE	13 OCT. 1999	

EASTERN EUROPE

23 STATES

● 23 RATIFIED

STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
ALBANIA	27 SEP. 1996	23 APR. 2003
ARMENIA	1 OCT. 1996	12 JUL. 2006
AZERBAIJAN	28 JUL. 1997	2 FEB. 1999
BELARUS	24 SEP. 1996	13 SEP. 2000
BOSNIA AND HERZEGOVINA	24 SEP. 1996	26 OCT. 2006
BULGARIA	24 SEP. 1996	29 SEP. 1999
CROATIA	24 SEP. 1996	2 MAR. 2001
CZECH REPUBLIC	12 NOV. 1996	11 SEP. 1997
ESTONIA	20 NOV. 1996	13 AUG. 1999
GEORGIA	24 SEP. 1996	27 SEP. 2002
HUNGARY	25 SEP. 1996	13 JUL. 1999
LATVIA	24 SEP. 1996	20 NOV. 2001
LITHUANIA	7 OCT. 1996	7 FEB. 2000
MONTENEGRO	23 OCT. 2006	23 OCT. 2006
POLAND	24 SEP. 1996	25 MAY 1999
REPUBLIC OF MOLDOVA	24 SEP. 1997	16 JAN. 2007
ROMANIA	24 SEP. 1996	5 OCT. 1999
RUSSIAN FEDERATION	24 SEP. 1996	30 JUN. 2000
SERBIA	8 JUN. 2001	19 MAY 2004
SLOVAKIA	30 SEP. 1996	3 MAR. 1998
SLOVENIA	24 SEP. 1996	31 AUG. 1999
THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA	29 OCT. 1998	14 MAR. 2000
UKRAINE	27 SEP. 1996	23 FEB. 2001

LATIN AMERICA AND THE CARIBBEAN

33 STATES

● 31 RATIFIED

● 2 NOT SIGNED

STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
ANTIGUA AND BARBUDA	16 APR. 1997	11 JAN. 2006
ARGENTINA	24 SEP. 1996	4 DEC. 1998
BAHAMAS	4 FEB. 2005	30 NOV. 2007
BARBADOS	14 JAN. 2008	14 JAN. 2008
BELIZE	14 NOV. 2001	26 MAR. 2004
BOLIVIA (PLURINATIONAL STATE OF)	24 SEP. 1996	4 OCT. 1999
BRAZIL	24 SEP. 1996	24 JUL. 1998
CHILE	24 SEP. 1996	12 JUL. 2000
COLOMBIA	24 SEP. 1996	29 JAN. 2008
COSTA RICA	24 SEP. 1996	25 SEP. 2001
CUBA		
DOMINICA		
DOMINICAN REPUBLIC	3 OCT. 1996	4 SEP. 2007
ECUADOR	24 SEP. 1996	12 NOV. 2001
EL SALVADOR	24. SEP 1996	11 SEP. 1998
GRENADA	10 OCT. 1996	19 AUG. 1998
GUATEMALA	20 SEP. 1999	12 JAN. 2012
GUYANA	7 SEP. 2000	7 MAR. 2001
HAITI	24 SEP. 1996	1 DEC. 2005
HONDURAS	25 SEP. 1996	30 OCT. 2003
JAMAICA	11 NOV. 1996	13 NOV. 2001
MEXICO	24 SEP. 1996	5 OCT. 1999
NICARAGUA	24 SEP. 1996	5 DEC. 2000
PANAMA	24 SEP. 1996	23 MAR. 1999
PARAGUAY	25 SEP. 1996	4 OCT. 2001
PERU	25 SEP. 1996	12 NOV. 1997
SAINT KITTS AND NEVIS	23 MAR. 2004	27 APR. 2005
SAINT LUCIA	4 OCT. 1996	5 APR. 2001
SAINT VINCENT AND THE GRENADINES	2 JUL. 2009	23 SEP. 2009
SURINAME	14 JAN. 1997	7 FEB. 2006
TRINIDAD AND TOBAGO	8 OCT. 2009	26 MAY 2010
URUGUAY	24 SEP. 1996	21 SEP. 2001
VENEZUELA (BOLIVARIAN REPUBLIC OF)	3 OCT. 1996	13 MAY 2002

MIDDLE EAST AND SOUTH ASIA

26 STATES

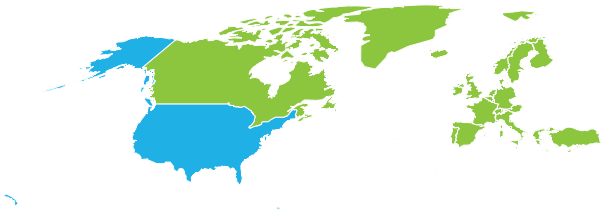
- 16 RATIFIED
- 5 SIGNED BUT NOT RATIFIED
- 5 NOT SIGNED

STATE	DATEOF SIGNATURE	DATEOF RATIFICATION
AFGHANISTAN	24 SEP. 2003	24 SEP. 2003
BAHRAIN	24 SEP. 1996	12 APR. 2004
BANGLADESH	24 OCT. 1996	8 MAR. 2000
BHUTAN		
INDIA		
IRAN (ISLAMIC REPUBLIC OF)	24 SEP. 1996	
IRAQ	19 AUG. 2008	26 SEP. 2013
ISRAEL	25 SEP. 1996	
JORDAN	26 SEP. 1996	25 AUG. 1998
KAZAKHSTAN	30 SEP. 1996	14 MAY 2002
KUWAIT	24 SEP. 1996	6 MAY 2003
KYRGYZSTAN	8 OCT. 1996	2 OCT. 2003
LEBANON	16 SEP. 2005	21 NOV. 2008
MALDIVES	1 OCT. 1997	7 SEP. 2000
NEPAL	8 OCT. 1996	
OMAN	23 SEP. 1999	13 JUN. 2003
PAKISTAN		
QATAR	24 SEP. 1996	3 MAR. 1997
SAUDI ARABIA		
SRI LANKA	24 OCT. 1996	
SYRIAN ARAB REPUBLIC		
TAJIKISTAN	7 OCT. 1996	10 JUN. 1998
TURKMENISTAN	24 SEP. 1996	20 FEB. 1998
UNITED ARAB EMIRATES	25 SEP. 1996	18 SEP. 2000
UZBEKISTAN	3 OCT. 1996	29 MAY 1997
YEMEN	30 SEP. 1996	

NORTH AMERICA AND WESTERN EUROPE

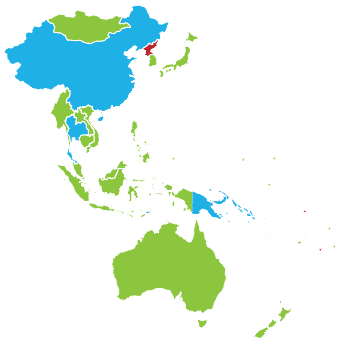
28 STATES

- 27 RATIFIED
- 1 SIGNED BUT NOT RATIFIED



STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
ANDORRA	24 SEP. 1996	12 JUL. 2006
AUSTRIA	24 SEP. 1996	13 MAR. 1998
BELGIUM	24 SEP. 1996	29 JUN. 1999
CANADA	24 SEP. 1996	18 DEC. 1998
CYPRUS	24 SEP. 1996	18 JUL. 2003
DENMARK	24 SEP. 1996	21 DEC. 1998
FINLAND	24 SEP. 1996	15 JAN. 1999
FRANCE	24 SEP. 1996	6 APR. 1998
GERMANY	24 SEP. 1996	20 AUG. 1998
GREECE	24 SEP. 1996	21 APR. 1999
HOLY SEE	24 SEP. 1996	18 JUL. 2001
ICELAND	24 SEP. 1996	26 JUN. 2000
IRELAND	24 SEP. 1996	15 JUL. 1999
ITALY	24 SEP. 1996	1 FEB. 1999
LIECHTENSTEIN	27 SEP. 1996	21 SEP. 2004
LUXEMBOURG	24 SEP. 1996	26 MAY 1999
MALTA	24 SEP. 1996	23 JUL. 2001
MONACO	1 OCT. 1996	18 DEC. 1998
NETHERLANDS	24 SEP. 1996	23 MAR. 1999
NORWAY	24 SEP. 1996	15 JUL. 1999
PORTUGAL	24 SEP. 1996	26 JUN. 2000
SAN MARINO	7 OCT. 1996	12 MAR. 2002
SPAIN	24 SEP. 1996	31 JUL. 1998
SWEDEN	24 SEP. 1996	2 DEC. 1998
SWITZERLAND	24 SEP. 1996	1 OCT. 1999
TURKEY	24 SEP. 1996	16 FEB. 2000
UNITED KINGDOM	24 SEP. 1996	6 APR. 1998
UNITED STATES OF AMERICA	24 SEP. 1996	

SOUTH EAST ASIA, THE PACIFIC AND THE FAR EAST



32 STATES

- 24 RATIFIED
- 5 SIGNED BUT NOT RATIFIED
- 3 NOT SIGNED

STATE	DATE OF SIGNATURE	DATE OF RATIFICATION
AUSTRALIA	24 SEP. 1996	9 JUL. 1998
BRUNEI DARUSSALAM	22 JAN. 1997	10 JAN. 2013
CAMBODIA	26 SEP. 1996	10 NOV. 2000
CHINA	24 SEP. 1996	
COOK ISLANDS	5 DEC. 1997	6 SEP. 2005
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA		
FIJI	24 SEP. 1996	10 OCT. 1996
INDONESIA	24 SEP. 1996	6 FEB. 2012
JAPAN	24 SEP. 1996	8 JUL. 1997
KIRIBATI	7 SEP. 2000	7 SEP. 2000
LAO PEOPLE'S DEMOCRATIC REPUBLIC	30 JUL. 1997	5 OCT. 2000

STATE (CONT.)	DATE OF SIGNATURE	DATE OF RATIFICATION
MALAYSIA	23 JUL. 1998	17 JAN. 2008
MARSHALL ISLANDS	24 SEP. 1996	28 OCT. 2009
MICRONESIA (FEDERATED STATES OF)	24 SEP. 1996	25 JUL. 1997
MONGOLIA	1 OCT. 1996	8 AUG. 1997
MYANMAR	25 NOV. 1996	21 SEP. 2016
NAURU	8 SEP. 2000	12 NOV. 2001
NEW ZEALAND	27 SEP. 1996	19 MAR. 1999
NIUE	9 APR. 2012	4 MAR. 2014
PALAU	12 AUG. 2003	1 AUG. 2007
PAPUA NEW GUINEA	25 SEP. 1996	
PHILIPPINES	24 SEP. 1996	23 FEB. 2001
REPUBLIC OF KOREA	24 SEP. 1996	24 SEP. 1999
SAMOA	9 OCT. 1996	27 SEP. 2002
SINGAPORE	14 JAN. 1999	10 NOV. 2001
SOLOMON ISLANDS	3 OCT. 1996	
THAILAND	12 NOV. 1996	
TIMOR-LESTE	26 SEP. 2008	
TONGA		
TUVALU		
VANUATU	24 SEP. 1996	16 SEP. 2005
VIET NAM	24 SEP. 1996	10 MAR. 2006

VERIFICATION REGIME OF THE TREATY

International Monitoring System

International Data Centre

On-Site Inspection