CTBTO
PREPARATORY COMMISSION

preparatory commission for the comprehensive nuclear-test-ban treaty organization

Annual Report 2014

www.ctbto.org

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 weapon. 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.

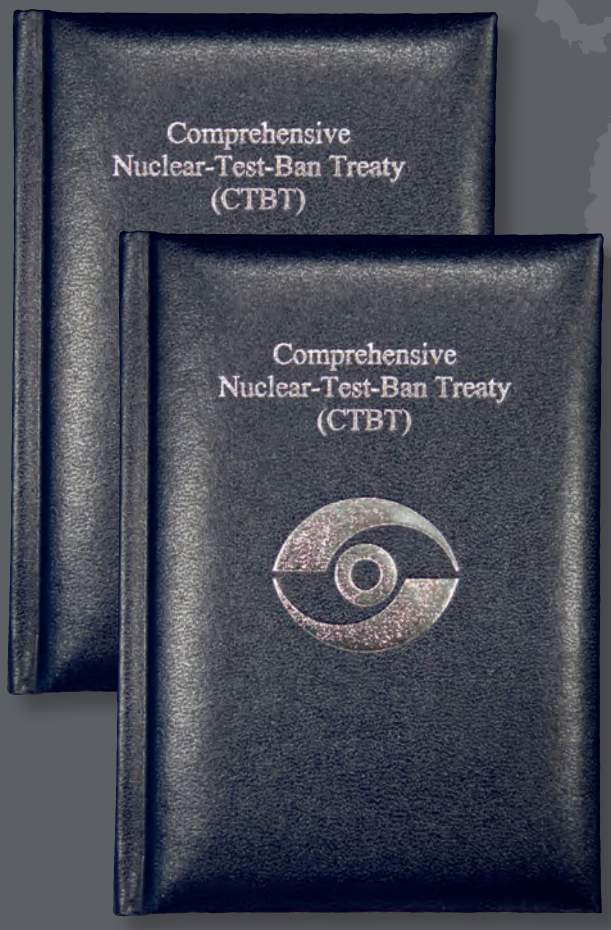
When the Treaty enters into force, the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) will be established in Vienna, Austria. The mandate of this international organization is to achieve the object and purpose of the Treaty, to ensure the implementation of its provisions, including those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

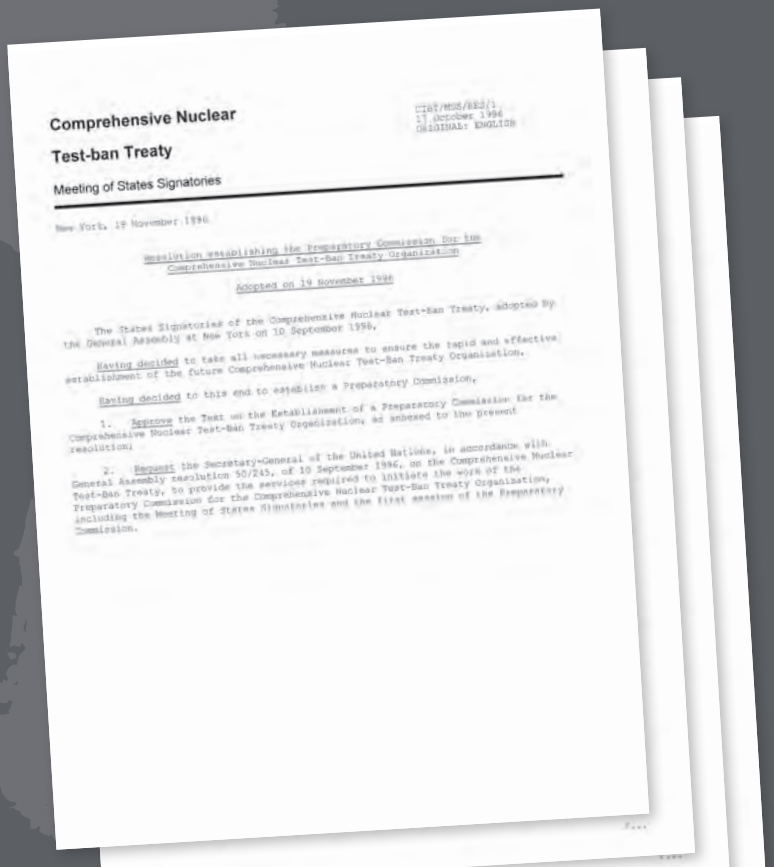
The Commission

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 map on the back cover shows 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
June 2015

Based on document CTBT/ES/2014/5, Annual Report 2014

Message
from the Executive Secretary

The Commission continued to make political and technical progress in 2014. Additional ratifications of the Treaty lent even more strength to the established norm against nuclear testing and to calls for the entry into force of the Treaty. The Commission received increasing appreciation for its work as it brought some major projects to conclusion.

This report highlights the main activities of the organization during the year.

With the ratification of the Treaty by Niue and the Congo, the number of ratifying States reached 163. This encouraged us to set a new milestone of attaining 170 ratifications in the near future.

Throughout the year, the organization held consultations with almost all States that had not yet ratified or signed the Treaty. In order to promote additional signatures and ratifications, it also liaised with a large number of ratifying States, the United Nations and other global and regional organizations.

I visited several States and met with foreign ministers and other senior officials during the year. These included Argentina, the Czech Republic, Ecuador, Ethiopia, Germany, Indonesia, Israel, Jordan, the Republic of Korea, the Russian Federation, Slovakia, Sweden, the United Arab Emirates, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

I also met with several heads of State and Government and many foreign ministers in Vienna and other locations. The heads of State and Government included the Presidents of Armenia, the Central African Republic, Chad, Chile, the Congo, Gabon, Guinea, Israel, Mauritania, Mongolia and South Sudan and the Prime Minister of Jordan.

It is encouraging to note that the heads of State and Government and the foreign ministers were united in their recognition of the importance of the Treaty and the work of the organization.

At the seventh Ministerial Meeting on promoting entry into force, held in New York on 26 September 2014, the ministers were unequivocal in their support for the Treaty. They discussed ways and means to further promote the Treaty and expressed their appreciation for the activities of the Commission in advancing its operational capabilities, including on-site inspection (OSI).

The Group of Eminent Persons (GEM) met in Stockholm in April 2014, bringing together a number of senior statesmen, active and former politicians, and internationally recognized experts. The meeting, hosted by the Government of Sweden, provided an opportunity to examine possible strategic approaches and modes of action for promotion of the Treaty and its entry into force.

The 2014 Integrated Field Exercise in Jordan was the largest ever field activity of the organization. It required three years of preparation, lasted for five weeks, and involved more than 360 experts and dignitaries from 53 States Signatories and the Secretariat. We intend to build on this remarkable experience and seek further advances in our OSI capabilities.

While providing continuous, near real time data and data products to States Signatories, we made notable progress in commissioning the International Data Centre (IDC). Several years of work went into achieving this new status of commissioning. Efforts included implementing the formal security measures to prevent external interference in or compromise of IDC operations and products. They also involved developing a draft validation and acceptance test plan, supporting the development of National Data Centres, bulletin production and running a monitoring and testing programme. We are now entering a phase of full-scale testing of the IDC hardware and software, in which the Secretariat verifies that the IDC, the International Monitoring System (IMS) and the Global Communications Infrastructure function according to their specifications.

In March the organization completed the multi-million-dollar reconstruction of hydroacoustic station HA3 in the Juan Fernández Islands, Chile. The project represented the largest reconstruction of an IMS station so far and demanded significant financial resources and technical expertise. The station has now been reintroduced to IDC operations and is working soundly. We also enhanced our noble gas monitoring coverage.

Following introduction of an integrated approach, our capacity building activities, workshops and educational programmes, in particular for developing countries, grew further in terms of variety and coverage. Over 1000 people benefited from our programmes. This is an investment whose aim is to help States Signatories to better fulfil their Treaty obligations and to use the data and products of the verification system more efficiently.

The Commission succeeded to complete implementation of its Enterprise Resource Planning project within budget and on time.

Time and again the Commission has proved to be an efficient and cost effective organization. As it takes on new challenges to further strengthen the international norm against nuclear testing and to complete its verification regime, the organization will continue to rely on the support of States Signatories.

Lassina Zerbo
Executive Secretary
CTBTO Preparatory Commission
Vienna, March 2015

Contents

Abbreviations

3-C	three component
ARAS	alternative radionuclide analysis system
ARR	Automatic Radionuclide Report
ATM	atmospheric transport modelling
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
ECS	Experts Communication System
ERP	Enterprise Resource Planning
ESMF	Equipment Storage and Maintenance Facility
EU	European Union
FIMS	field information management system
FTF	field team functionality
GCI	Global Communications Infrastructure
GEM	Group of Eminent Persons
GIS	geographical information system
IAEA	International Atomic Energy Agency
IDC	International Data Centre
IFE	Integrated Field Exercise
IIMS	integrated information management system
IMS	International Monitoring System
IPSAS	International Public Sector Accounting Standards
IPU	Inter-Parliamentary Union
ISTHAR	Information System with Hyperlinks on Tasks Assigned by the Resolution Establishing the Preparatory Commission
IT	information technology
ITF	inspection team functionality
KPI	key performance indicators
MPLS	multiprotocol label switching
MSIR	multispectral imaging including infrared
NDC	National Data Centre
O&M	operation and maintenance
OSC	Operations Support Centre
OSCE	Organization for Security and Co operation in Europe
OSI	on-site inspection
OSIRIS	OSI Rapid Inspector Selection
PCA	post-certification activity
PKI	Public Key Infrastructure
PRTool	performance reporting tool
PTE	Proficiency Test Exercise
QA/QC	quality assurance and quality control
QMS	Quality Management System
REB	Reviewed Event Bulletin
RN/NG	radionuclide and noble gas
RRR	Reviewed Radionuclide Report
RSTT	regional seismic travel time
SAMS	Seismic Aftershock Monitoring System
SOH	state of health
SOP	standard operating procedure
SSM	Swedish Radiation Safety Authority
SSO	single sign-on
VPN	virtual private network
VSAT	very small aperture terminal
VSF	Voluntary Support Forum
WIN	work instruction
WGA	Working Group A
WGB	Working Group B
WMO	World Meteorological Organization

Summary

The Commission reached a number of milestones and set some new records in 2014.

It made further progress towards the completion of the International Monitoring System (IMS), with an emphasis on noble gas systems. It certified 4 noble gas systems and upgraded 2 others. The Treaty foresees the installation of 40 noble gas systems: by the end of the year, the Commission had installed 31, including 22 that had been certified. The performance of the verification regime in response to the announced nuclear tests by the Democratic People's Republic of Korea (in 2006 and 2013) and the Fukushima nuclear accident in Japan in 2011 highlighted the importance of these systems.

The Commission made its first certification of a laboratory for noble gas measurement in 2014. This adds a new functionality to certified IMS activities that is crucial for quality assurance and quality control of the noble gas capability of the organization.

The Commission also continued to recapitalize (i.e. replace) and upgrade IMS facility components as they reached the end of their planned operating lives. These activities involved substantial investment of human and financial resources. Notably, the organization completed its largest ever repair operation: the re-establishment of hydroacoustic station HA3 on Juan Fernández Islands, Chile. Since the station was reintroduced to International Data Centre (IDC) operations, its performance has been flawless.

States Signatories continued to receive near real time high quality data and data products from the IDC. After several years of effort, the organization reached the milestone of meeting the requirements for moving from Phase 5a to Phase 5b of the IDC Progressive Commissioning Plan. These included implementing formal security measures to prevent external interference in or compromise of IDC operations and products and developing a draft validation and acceptance test plan. They also involved supporting the development of National Data Centres (NDCs), bulletin production, and running a monitoring and testing programme.

The organization has now entered a full scale testing phase for the IDC hardware and software, in which it verifies that the IDC, the IMS and the Global Communications Infrastructure (GCI) function according to their specifications. The outputs of these activities, including test reports and performance monitoring results, will provide material for inspection and analysis during validation and acceptance (Phase 6 of IDC commissioning).

The conduct of the 2014 Integrated Field Exercise (IFE) in Jordan was a milestone in the development of the on-site inspection (OSI) capabilities of the Commission. This exercise, the largest ever field activity of the organization, took three years of preparation in areas such as policy planning, operations support and logistics, training, scenario designing, equipment and technique testing, coordination, and documentation and procedures.

Exercise activities were led and coordinated by a joint exercise management team comprised of Secretariat staff and representatives of the host State. Exercise players were divided into three groups: the inspection team, the inspected State Party and, in Austria, the Operations Support Centre (OSC). Non-exercise players comprised the control and evaluation teams, which had the respective tasks of controlling the exercise play and independently evaluating the IFE. A number of opportunities were provided for the State Signatories to participate in and observe the exercise at various venues, including through briefings at the OSC.

The IFE lasted for five weeks and tested crucial aspects of each phase of an on-site inspection, both in Jordan and at the OSC. It required that 150 tonnes of equipment, worth $10 million, be shipped to Jordan. More than 360 experts and dignitaries from 53 States Signatories and the Secretariat participated in the event in various roles and functions. The exercise generated significant media interest and enjoyed the participation of senior officials of States Signatories, other international organizations and members of the Group of Eminent Persons (GEM), who followed various parts of the exercise.

In short, the exercise proved the readiness of the organization to carry out an OSI and established a major benchmark for its application.

The Commission took additional steps to improve its efficiency and increase quality management through results based management, enhanced accountability and oversight. In this respect, it continued to develop and consolidate the Quality Management System. It also made progress in enhancement of the performance reporting tool and refinement of the key performance indicators. Internal Audit continued to ensure compliance with regulations and rules and applicable procedures, and to provide recommendations to further improve economy and efficiency.

The organization expanded its capacity building and educational activities during the year. Over 1000 experts, in particular from developing countries, participated in the capacity building programmes. The Commission also integrated all its e-learning systems to offer a one-stop shop platform.

Promotion of the Treaty and its universalization continued to be the focus of outreach activities. The Executive Secretary and GEM members took every opportunity to encourage further signature and ratification of the Treaty, including through engaging proactively with media, especially in Annex 2 States. The Executive Secretary met with a considerable number of Heads of State and Government and foreign ministers and sought their cooperation in advancing the entry into force of the Treaty.

The Seventh Ministerial Meeting on Promoting the Entry into Force of the Treaty, held in September in New York, was an occasion to renew and increase political momentum and public support for entry into force. The ministers issued a joint statement that highlighted the contribution of the Treaty to global nuclear disarmament and non-proliferation. The statement also acknowledged the role of GEM in assisting the entry into force process and underlined the role of the IFE in advancing the OSI operational capabilities of the Commission.

To provide a transparent and open forum for informal consultations with the donor community, the Voluntary Support Forum was initiated in 2014. At the first of its two meetings, participants discussed projects for which the organization sought voluntary contributions. At its second meeting, the forum received further detailed information from project managers. The total budget required for the projects is around US$5 million.

The Commission completed implementation of Enterprise Resource Planning (ERP) within budget and on time. The system has been in operation since May 2014 without notable problems. It was stabilized during the remaining part of the year and a steady-state support and governance structure is being established.

The 2014 Integrated field Exercise was an important leap in operational capability for on-site inspection

Oleg Rozhkov
Director, On-Site Inspection Division

Further progress was made towards universality of the Treaty

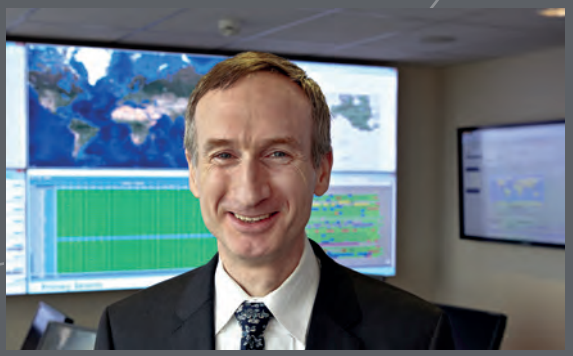
Genxin Li
Director, Legal and External Relations Division

The complex, multimillion dollar project to repair the IMS hydroacoustic facility in Chile was completed

Nurcan Meral Ozel
Director, International Monitoring System Division

Implementation of the IPSAS-compliant Enterprise Resource Planning system was an advance for efficiency and transparency

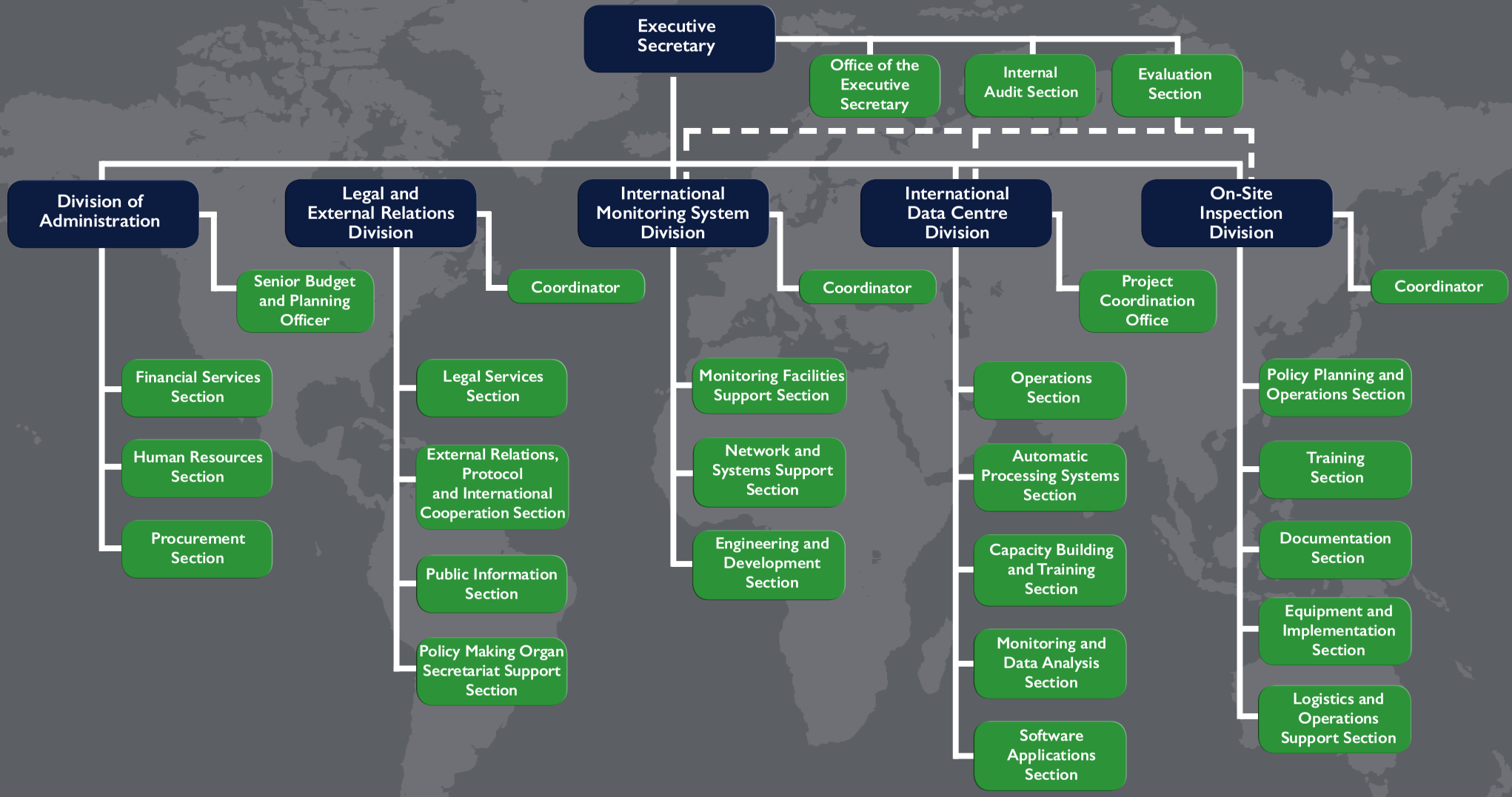
Thierry Dubourg
Director, Administration Division



Requirements were met to move to a higher level of IDC progressive commissioning

Randy Bell
Director, International Data Centre Division

Organizational Structure of the Provisional Technical Secretariat as of 31 December 2014



Reconstruction of hydroacoustic station HA3, Juan Fernández Islands, Chile

Highlights in 2014

Enhanced coverage for noble gas monitoring

First certification of an IMS laboratory for noble gas measurement capability

Completion of the largest re-establishment of an IMS station (HA3 in Chile)

The International Monitoring System (IMS) is a global network of sensors for detecting and providing evidence of possible nuclear explosions. When completed, the IMS will consist of 321 monitoring stations and 16 radionuclide laboratories in 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 energy released by an explosion – whether nuclear or non-nuclear – or natural event that takes place underground, underwater or in the atmosphere.

The IMS uses radionuclide monitoring technologies to collect particles and, at a growing number of stations, noble gases from the atmosphere. The samples are then 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.

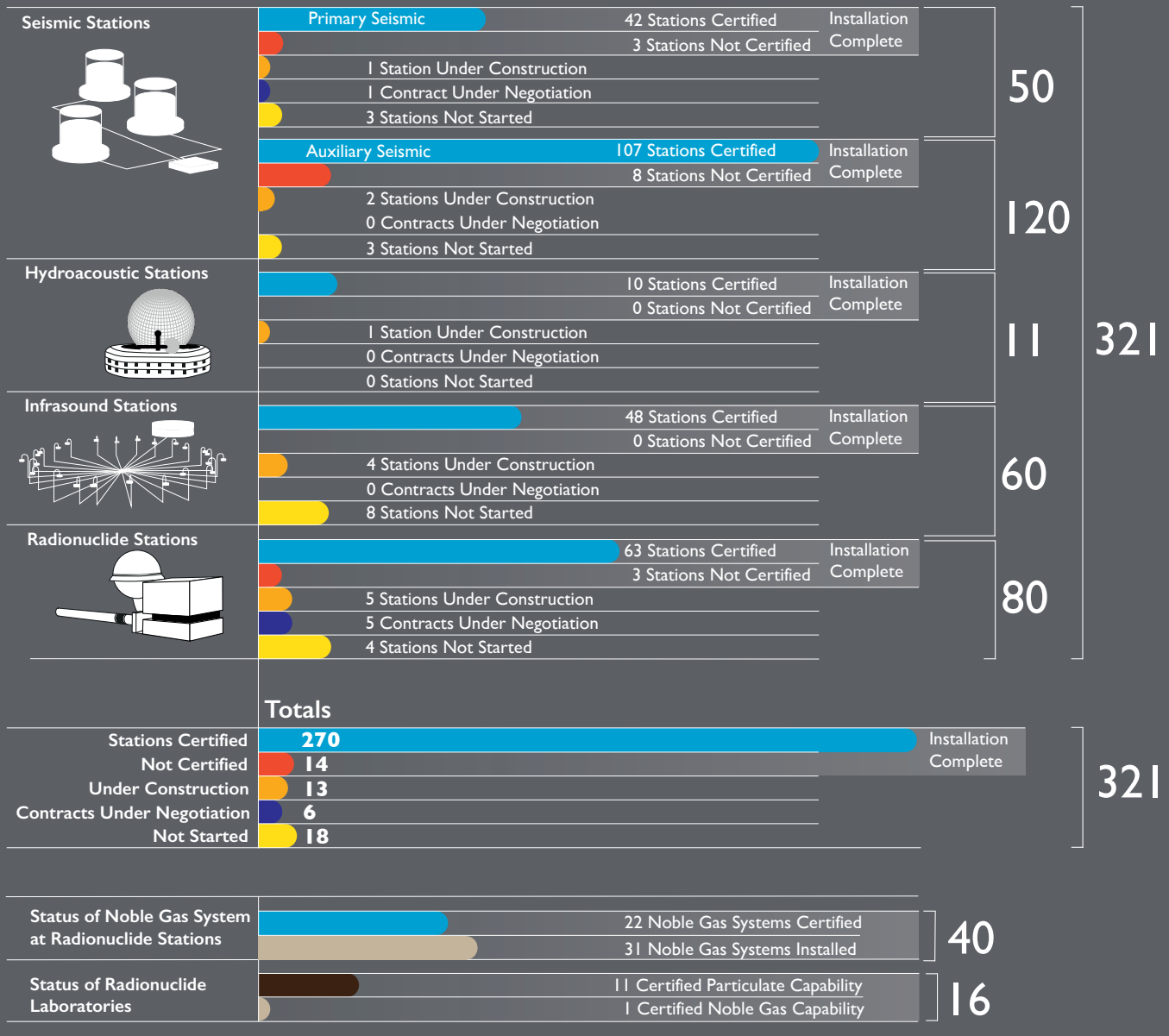
Completing the International Monitoring System

In 2014 the Commission maintained the momentum towards completion of the IMS network. It made progress in all four technologies – seismic, hydroacoustic, infrasound and radionuclide – with the installation, testing and certification of new facilities and the upgrading of existing facilities.

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 line with its priorities, the Commission made its most significant progress in 2014 in the noble gas monitoring programme: it certified noble gas systems at four radionuclide stations (RN16 and RN17 in Canada, RN38 in Japan and RN46 in New Zealand) and upgraded two

IMS Installations and Certifications as of 31 December 2014



systems. Monitoring of radionuclide noble gases plays an essential role in the Treaty's verification system, as was demonstrated for the Democratic People's Republic of Korea announced nuclear tests in 2006 and 2013. It also proved to be invaluable following the nuclear accident at Fukushima, Japan, in 2011. The Commission therefore continued to place emphasis on this technology in 2014. By the end of the year, it had installed 31 noble gas systems (78% of the planned total of 40) at IMS radionuclide stations, including 22 that it had certified as meeting its stringent technical requirements. The addition of these systems significantly strengthens the capacity of the IMS and continues the dynamic approach to the establishment of the verification system.

Following the adoption of the certification requirements and processes for noble gas laboratories by the Commission in 2012, a major milestone for the IMS was reached on 16 December 2014 with the first certification of an IMS laboratory (RL3 at Seibersdorf, Austria) for noble gas measurement capability. This adds a new functionality to the certified IMS activities that is crucial for the quality assurance and quality control (QA/QC) of IMS noble gas measurements. This achievement had been preceded by the development of certification criteria and certification procedures and by the build-up of technical capabilities at IMS laboratories in previous years. The Commission plans to certify additional IMS laboratories for noble gas measurement capabilities in the coming years.

The Commission installed two more IMS stations in 2014, bringing the total number of stations installed to 284 (88% of the network foreseen by the Treaty).

The organization also certified three IMS stations in 2014 as meeting all technical requirements (IS40 in Papua New Guinea, AS31 in Fiji and AS94 in the Russian Federation). The total number of certified IMS stations and laboratories thus reached 281 (83% of the network foreseen by the Treaty), improving both the coverage and the resilience of the network.

Substantial work continued on re establishment of station HA4 (Crozet Island, France, in the southern Indian Ocean), which is the only uncertified IMS hydroacoustic station. The Commission carried out a wide ranging assessment on all aspects of installation of the station, with the aim of reducing the risks associated with the project. The assessment surveyed the most up to date information on

Top: St. John's, Newfoundland and Labrador, Canada, location of radionuclide station RN17
Middle: Radionuclide station RN38, Takasaki, Gunma, Japan
Bottom: Auxiliary seismic station AS94, Belogornoe, Russian Federation

the local environment provided in expert environmental, acoustic modelling and bathymetric studies. This preparatory work led in December 2014 to the signature of a contract to re-establish the station.

Preparation work also progressed to install and certify further IMS facilities. Notably, a contract was concluded to establish infrasound station IS3 in Australia. At the end of 2014, preparations were under way to install or certify about 10 further IMS stations and laboratories in 2015.

During 2014 the Commission received political support from several States that host IMS facilities at which work had not been able to proceed in previous years. In particular, there were promising developments to establish some of the remaining IMS stations in South America. The organization also took major steps towards the completion of the IMS stations in China and the Russian Federation. All of these advances contribute to the prospect of the completion of the IMS network.

These advances are not just about enhancements in global coverage and data flow. They also help with the effective application of the monitoring technologies around the globe; helping stakeholders gain more experience; and improving the quality of data processing and data products. All of which contribute to enhancing global security.

Agreements for Monitoring Facilities

The Commission has the mandate to establish procedures and a formal basis for the provisional operation of the IMS. 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 derive full 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

Top and middle: Installation and certification of infrasound station IS40, Keravat, Papua New Guinea
Bottom: Noble gas measurement equipment at radionuclide laboratory RL3, Seibersdorf, Austria

one or more IMS facilities to adopt national measures to bring these privileges and immunities into effect.

Facility Agreements

In 2014 the Commission continued to address the importance of concluding facility agreements and arrangements and their subsequent national implementation. The lack of some such legal mechanisms continued to cause substantial costs (including in human resources) and major delays in sustaining certified IMS facilities. These costs and delays adversely affect the data availability of the verification system.

Of the 89 States that host IMS facilities, 46 have signed a facility agreement or arrangement with the Commission, and 38 of these agreements and arrangements are in force. At the end of 2014, the Commission was in negotiation with 5 of the 43 host States that had not yet concluded a facility agreement or arrangement. States are showing increased interest in the subject and it is hoped that ongoing negotiations may be concluded in the near future and that negotiations with other States may be initiated soon.

Post-Certification Activity

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 Commission's total expenditure related to PCAs in 2014 was US$18 633 842.32. This amount covers the applicable costs related to PCAs in 2014 for 161 facilities and noble gas systems certified up to 31 December 2014, including the 11 certified radionuclide laboratories and 16 of the noble gas systems.

Each station operator submits a monthly report on PCA performance, which the Commission reviews for compliance with operation and maintenance (O&M) plans. Standardized criteria for the review and evaluation of the performance of station operators have been developed.

Top: An array element at infrasound station IS16, Kunming, China
Middle: Auxiliary seismic station AS31, Monasavu, Viti Levu, Fiji
Bottom: Signing of surveillance visit summary at radionuclide laboratory RL9, Yavne, Israel

In 2014 the Commission continued to standardize the services provided under PCA contracts. It requested that station operators of all newly certified stations and of existing stations that submitted new budget proposals develop O&M plans in accordance with a standard template. In 2014 O&M plans for 28 more 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 95.

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 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.

The support activities for IMS facilities in 2014 continued to emphasize preventive maintenance and the recapitalization of IMS stations and station components as they reach the end of their lives. Improvement of internal processes and mechanisms was also prioritized to expedite the repair of IMS stations. In particular, efforts focused on ensuring greater interoperability of the different functional areas (logistics, maintenance, engineering, operations and the GCI). The Commission also intensified its efforts to develop engineering solutions to improve station robustness and performance and to enhance associated IMS monitoring technologies.

Optimizing and enhancing performance also involve the continuous improvement of data quality, reliability and resilience. Hence, the Commission continued to place importance on QA/QC, on facility calibration activities (which are essential for the reliable interpretation of detected signals) and on 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 such a global network of facilities calls for an integrated approach to logistics that seeks continuous validation and optimization. In 2014 the Commission further developed its IMS station specific models using software tools for logistics support analysis. Its efforts concentrated on further analysing and refining IMS station life cycle cost and reliability variables and validating them with the station operators and various stakeholders for several subsets of IMS stations. Models developed based on these variables enable informed decisions on optimizing the support and performance of the IMS network to achieve the required network operational availability at optimal cost.

Effective configuration management strengthens overall confidence that IMS monitoring facilities continue to meet IMS technical specifications and other requirements for certification. It ensures that changes at stations are rigorously assessed to determine their effect. It also reduces costs, effort and unforeseen drops in data availability when the changes are implemented. In 2014 the Commission implemented and tested revised internal IMS configuration management procedures that had been introduced at the end of 2013. It identified requirements for further improvement in the procedures. It also conducted physical configuration audits at certified IMS monitoring stations when performing maintenance visits. The initial results indicate that 83% of the items audited matched the information contained in the Database of the Technical Secretariat (DOTS).

The Commission continued in 2014 to work with host States and station operators to further streamline country specific shipment procedures for IMS equipment and consumables and ensure their timely and cost-free customs clearance. Shipping time and customs clearance processes continue to be very time-consuming, which increases the time taken to repair an IMS station and reduces the data availability of that station. The Commission therefore

continued its work to optimize the location and storage of IMS equipment and consumables at regional, country specific and supplier depots, at the stations themselves and at the storage facility near Vienna.

Maintenance

The Commission provides maintenance support and technical assistance at IMS facilities around the globe. During 2014 it addressed more than 167 maintenance tickets, including long running data availability problems at 12 IMS facilities. It also made a total of 10 preventive and corrective maintenance visits to 12 certified IMS facilities. This low figure demonstrates an increased reliance on contractors and other sources of support to perform such tasks.

The organization completed the largest IMS station reconstruction so far in terms of technical challenge and cost. The reconstructed station, the cabled hydrophone hydroacoustic station HA3 in the Juan Fernández Islands (Chile), had been damaged by a tsunami in 2010 and its re-establishment entailed substantial technical challenges and risks. The station has operated flawlessly since being re-established and reconnected to IDC operations.

The Commission continued to establish and manage long term support contracts with IMS equipment manufacturers as well as other support providers. Some of these contracts were also 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, materials and technical services on a 'call-off' basis. Both types of contract 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 a timely resolution when they occur. In 2014 the Commission also continued to emphasize developing the technical capabilities of station operators. As well as technical training for operators, station visits by staff of the Secretariat continued to include hands-on training for local staff, with the aim of avoiding the need for staff to travel from Vienna to resolve future problems.

Continuously updated and reliable technical documentation for each IMS station is essential to ensure its sustainability

Top: Laying of the underwater cable during reconstruction of hydroacoustic station HA3, Juan Fernández Islands, Chile
Bottom: Chart of underwater cabling at Juan Fernández Islands, Chile

and to maintain a high level of data availability. In 2014 the Commission made substantial progress in the revision of IMS station specific documentation and the establishment of processes to routinely keep such documentation up to date. The process of gathering, validating, verifying and managing station specific information for all certified IMS stations is in progress.

The combination of technical training for station operators and enhanced coordination between the operators and the Commission to optimize PCA contracts, station specific O&M plans and station summary reports has been successful. The abilities of station operators continued to improve in 2014, in particular in complying with Commission requirements and best practices in preventive maintenance and configuration management. This is essential for optimizing the sustainment and performance of the IMS network and enhancing the skills of station operators to undertake more sophisticated maintenance tasks at their stations.

Recapitalization

The final phase in the life cycle of equipment for IMS facilities involves its replacement (known as recapitalization) and disposal. In 2014 the Commission continued to recapitalize IMS facility components as they reached the planned end of their operating lives.

In managing recapitalization, the Commission and the 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 where failure would cause significant downtime. At the same time, recapitalization of components that proved to be robust and reliable was delayed beyond their planned end of life, where suitable, in order to optimize the use of available resources.

Several major station recapitalization projects involved substantial investment of human and financial resources in 2014. In three cases (AS108 in the United States of America, IS26 in Germany and PS40 in Spain), recapitalization was followed by revalidation in order to ensure that the technical requirements continue to be met. Several major IMS station upgrades were also under

Top: Microbarometer adjustment during recapitalization and revalidation of infrasound station IS26, Freyung, Germany
Bottom: GPS site survey at IS26, Freyung, Germany.

way at the end of 2014, in particular at AS112 in the USA, PS28 in Norway and PS45 in Ukraine.

Engineering Solutions

The engineering and development programme for IMS facilities aims to improve the overall data availability and quality, 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 2014 the Commission carried out several complex repairs that required substantial engineering work and infrastructure and equipment improvements at certified IMS facilities. In particular, major upgrades were carried out at PS22 in Japan, PS28 in Norway and IS44 in the Russian Federation. Major repairs were also conducted at stations IS43 and IS45 in the Russian Federation. Meanwhile, the Commission made efforts to optimize and formalize engineering processes, and achieved progress in developing technical drawings for waveform and radionuclide stations.

Performance of the IMS-wide state of health (SOH) system improved in 2014 and adequate accessibility was provided to all States Signatories. As well as being an essential tool to identify and troubleshoot failures, the SOH system supports trend analysis that allows the Commission to take preventive action. Analysis of station failures assists in the identification of the main causes of data loss and in the subsequent analysis of subsystem failures responsible for downtime. The outcome of these activities provides valuable input to prioritize the design, validation and implementation of improvements to IMS stations and technologies.

In 2014 the Commission also concentrated efforts on enhancing power supply and station security systems at several IMS stations. Other projects included:

- A technical assessment of solutions to sustain mission capability of arrays with single broadband elements;
- Preparations to establish call-off contracts for IMS station communication systems and wind noise reduction systems for IMS infrasound stations;
- Design of detector cooling techniques for radionuclide stations;
- Development of temporary replacement solutions for noble gas stations because of the importance of the IMS noble gas monitoring capabilities;
- Assessment of the next generation of hydroacoustic stations and potential temporary solutions because of the importance of each hydroacoustic station to IMS monitoring capabilities.

These initiatives contributed to improving the reliability and resilience of IMS facilities. By doing so, they also enhanced the performance of the network and increased the robustness of the IMS stations, contributing to extending their useful life and containing data downtime risks.

Auxiliary Seismic Network

The Commission continued to monitor the operation and sustainment of auxiliary seismic stations in 2014. 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 that are located in developing countries and 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, for several host States, obtaining the appropriate level of technical and financial support remains difficult.

In this respect, in 2014 the European Union continued to provide useful support for 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, provision of transportation and funds for additional personnel in the Secretariat to provide technical support. The Commission

continued 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 stations, the Commission pays great attention to ensuring a reliable and trustworthy IMS network. Hence, engineering and development activities in 2014 continued to focus on measures for data surety and on calibration. Calibration plays a significant role in the verification system as it determines and monitors, by measurement or comparison against a standard, parameters needed to properly interpret signals recorded by IMS facilities.

In the IMS seismic and infrasound networks, the Commission focused in 2014 on the improvement of calibration procedures, station operator training and identification of remaining system integration problems. In addition, the Commission continued the scheduled calibration of primary and auxiliary seismic stations and introduced the calibration of infrasound stations. The test deployment of the first self-calibrating infrasound sensor at a station was a major step forward in the development of the infrasound calibration programme. The Commission also initiated calibration procedures for T phase hydroacoustic stations and in November 2014 performed the first scheduled calibration at a T phase hydroacoustic station (HA9 on Tristan da Cunha, UK, in the South Atlantic Ocean).

During 2014, 163 QA/QC samples from 58 certified radionuclide particulate stations were sent to 9 laboratories for reanalysis. In addition, 26 Level 5 samples were split and sent to laboratories to confirm the identification of anthropogenic radionuclides. The QA/QC programme for laboratories continued with the organization of the 2014 interlaboratory comparison, the Proficiency Test Exercise (PTE). Evaluation of the 2013 PTE was also completed. All 16 IMS laboratories – both the 11 certified and the 5 non-certified laboratories – achieved a very good success rate. The laboratory surveillance assessments conducted at laboratories RL8 in France and RL15 in the UK were also successfully completed during 2014.

In the QA/QC programme for noble gas, by the end of 2014, 6 of the 16 IMS laboratories had developed capabilities to analyse noble gases. Under this test programme, 50 samples from 9 stations were analysed at 5 laboratories. The outcome of this reanalysis provides the basis for the development of a routine QA/QC programme for noble gas systems.

In an ever growing but also ageing IMS network, ensuring data availability is a daunting task. But, 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.

Seismic Stations

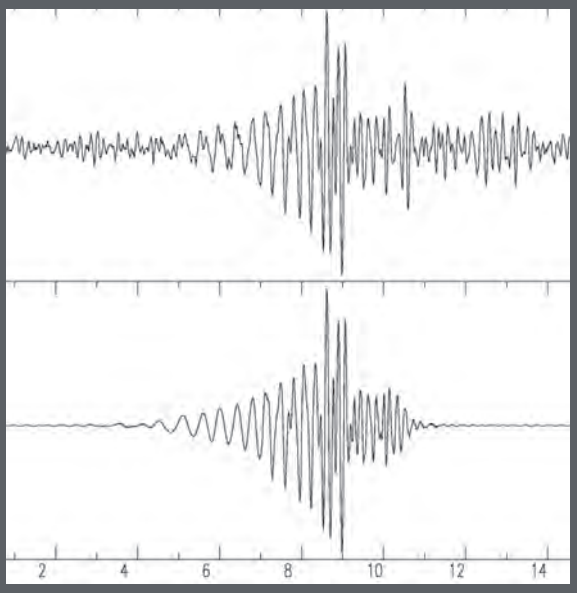
The objective of seismic monitoring is to detect and locate underground nuclear explosions. Earthquakes and other natural events as well as anthropogenic events generate two main types of seismic wave: body waves and surface waves. The faster body waves travel through the interior of the earth while 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.

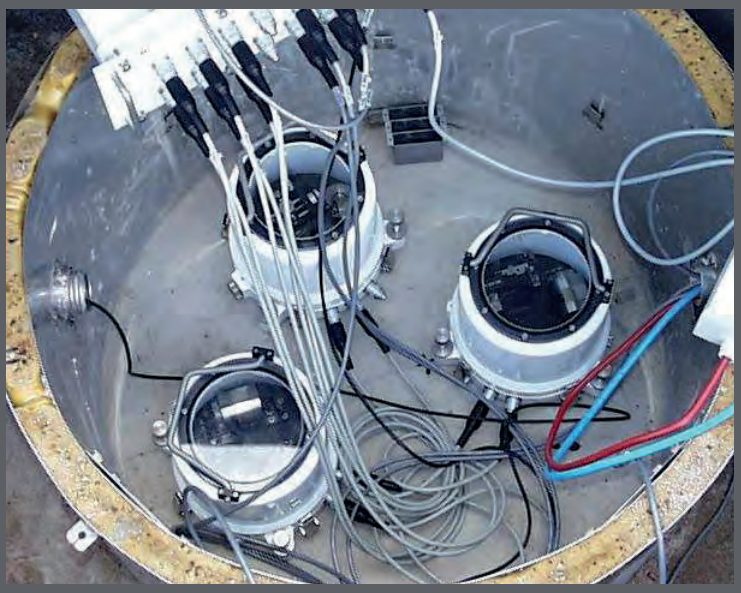
Seismic technology is very efficient at detecting a suspected nuclear explosion, as seismic waves travel fast and can be registered within minutes of an event. Data from seismic stations of the International Monitoring System provide information on the location of a suspected underground nuclear explosion 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 International Data Centre. Auxiliary seismic stations provide data on request from the IDC.

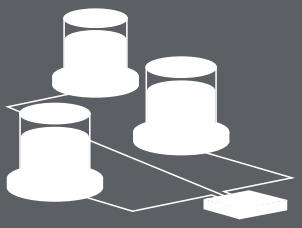
An IMS seismic station typically has three basic parts: a seismometer to measure ground motion, a recording system, which records the data digitally with an accurate time stamp, and a communication system interface.

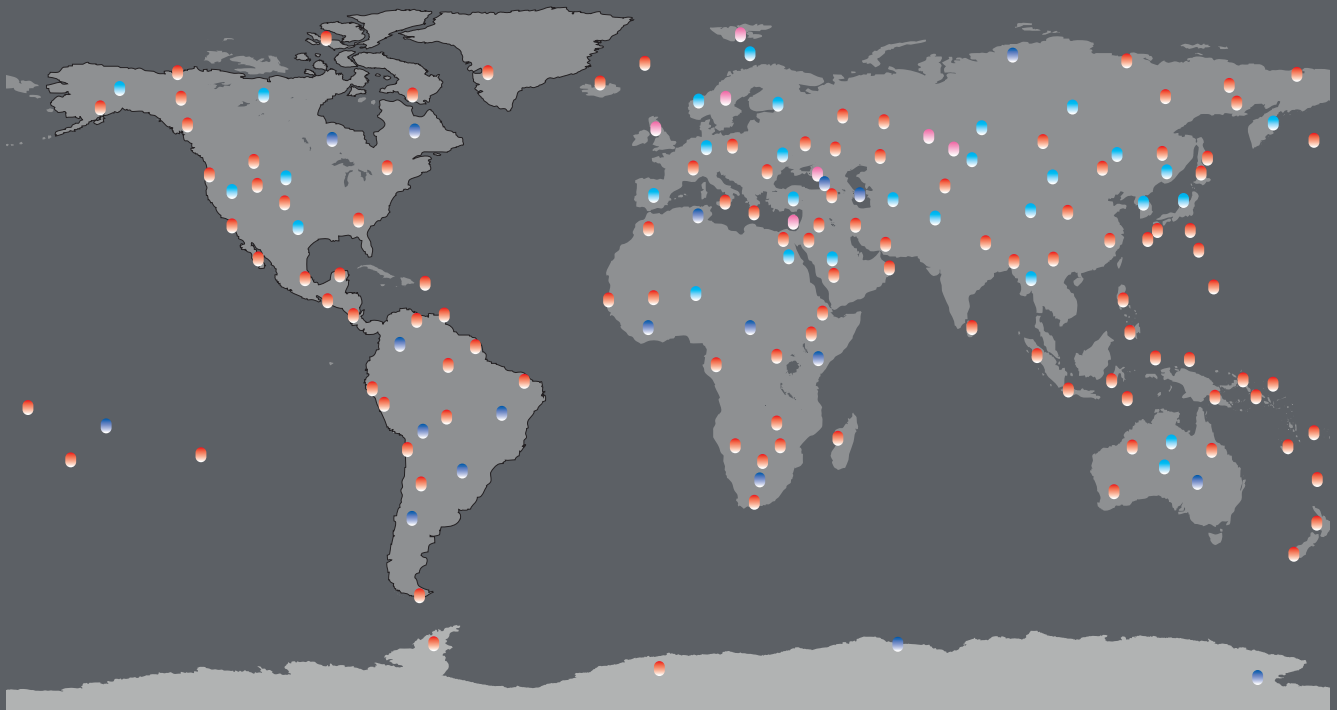
An IMS seismic station can be either a three component (3-C) station or an array station. A 3-C seismic station records broadband ground motion in three orthogonal directions. An IMS seismic array station generally consists of multiple short period seismometers and 3-C broadband instruments that are 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).





170 stations – 50 primary and 120 auxiliary – in 76 countries





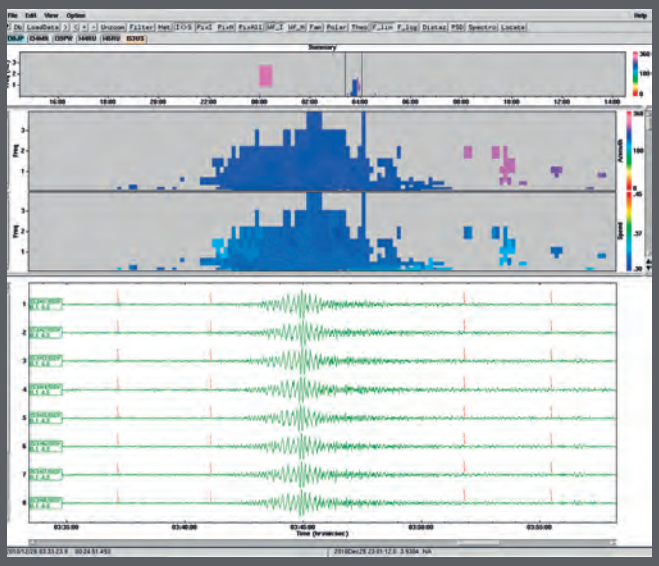
Infrasound Stations

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.

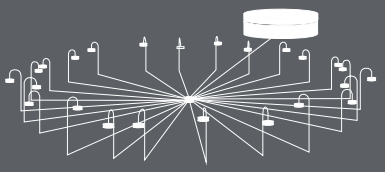
Infrasound waves cause minute changes in the atmospheric pressure that are measured by microbarometers. Infrasound has the ability to cover long distances with little dissipation, which is why infrasound monitoring is a useful technique for detecting and locating atmospheric nuclear explosions. In addition, 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.

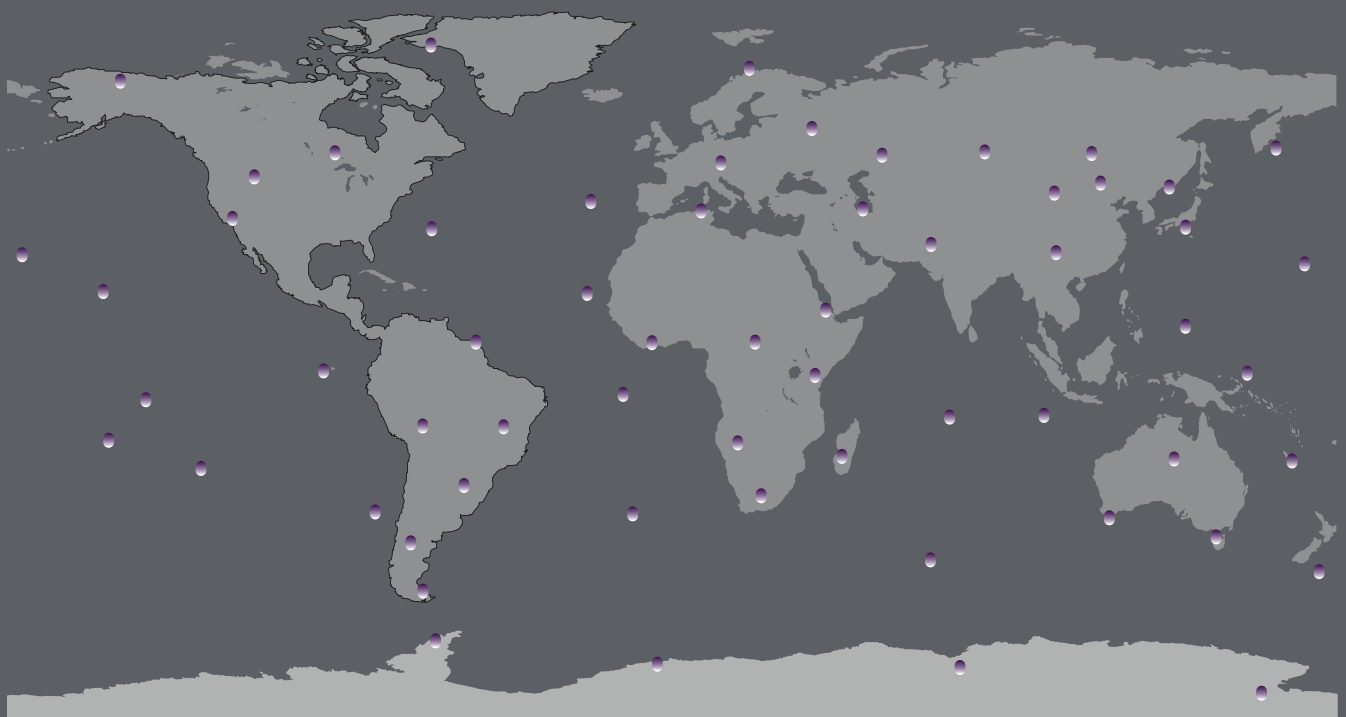
The IMS infrasound stations exist in a wide variety of environments, ranging from equatorial rainforests to remote windswept islands and polar ice shelves. However, an ideal site for deploying an infrasound station is within a dense forest, where it is protected from prevailing winds, or at a location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



60 stations in 34 countries





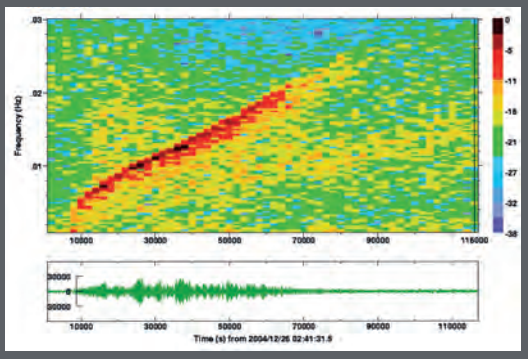
Hydroacoustic Stations

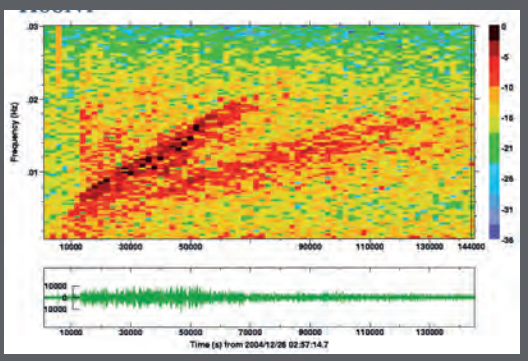
Nuclear explosions underwater, in the atmosphere near the ocean surface or underground near oceanic coasts generate sound waves that can be detected by the IMS hydroacoustic monitoring network.

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 oceans.

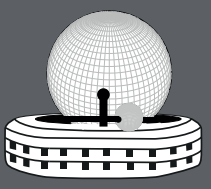
There are two types of hydroacoustic station: underwater hydrophone stations and T phase stations on islands or on the coast. The hydrophone stations, involving underwater installations, are among the most challenging and most costly monitoring stations to build. The installations must be designed to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

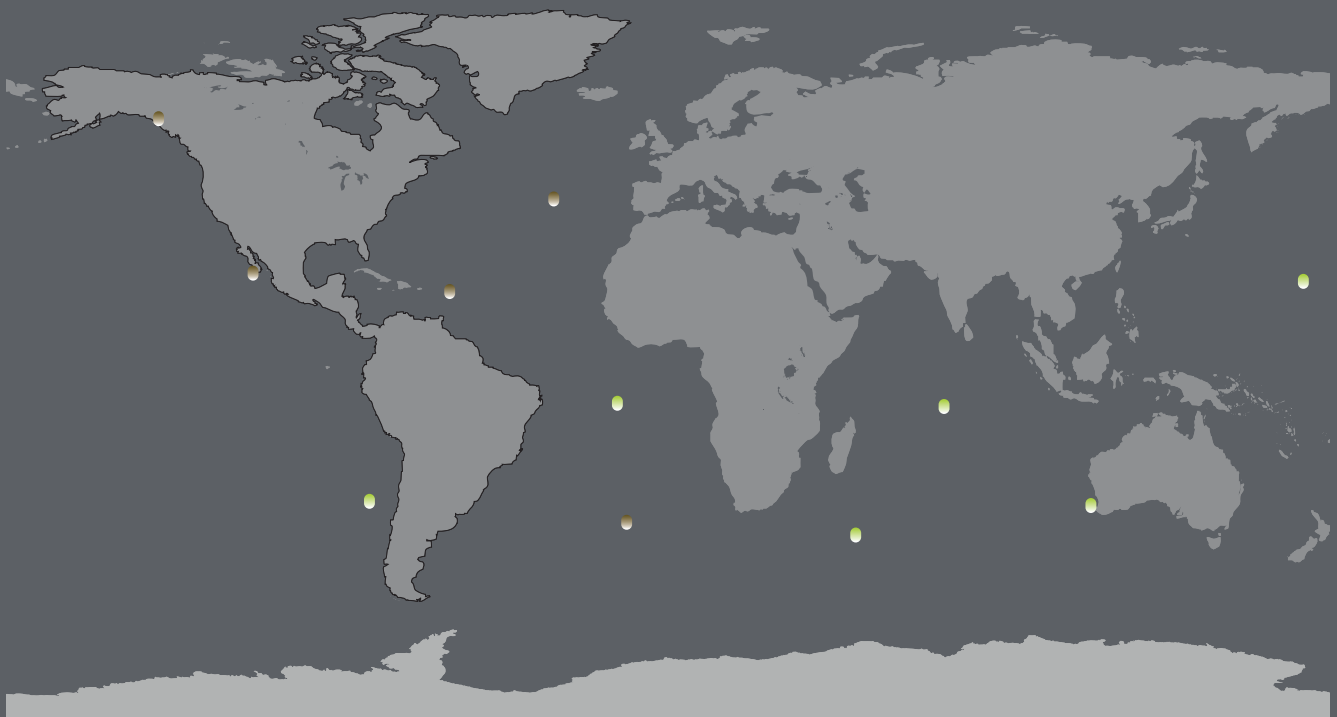
The deployment of the underwater parts of a hydrophone station (i.e. placing the hydrophones and laying the cables) is a complex undertaking. It involves the hiring of ships, extensive underwater work, and the use of specially designed materials and equipment.

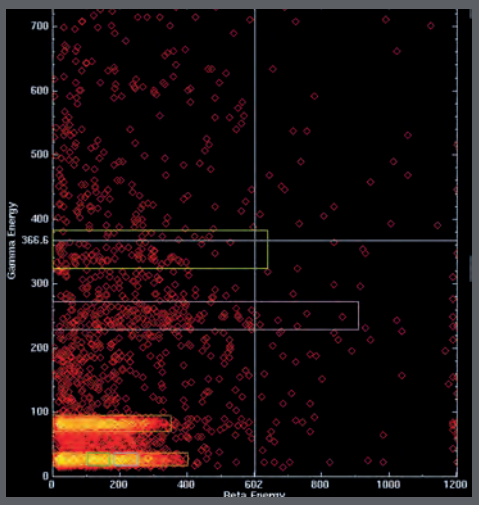




11 stations — 6 underwater hydrophone stations and 5 T phase stations on land — in 8 countries



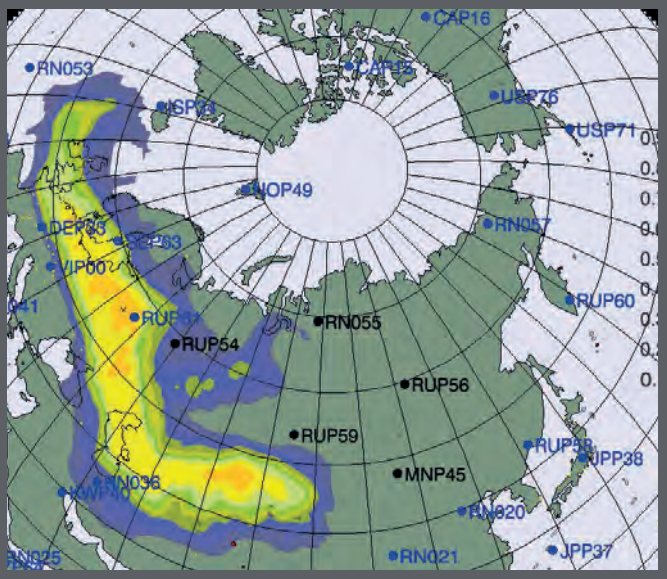




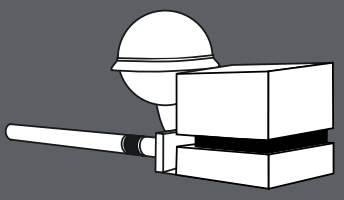
Radionuclide Particulate Stations

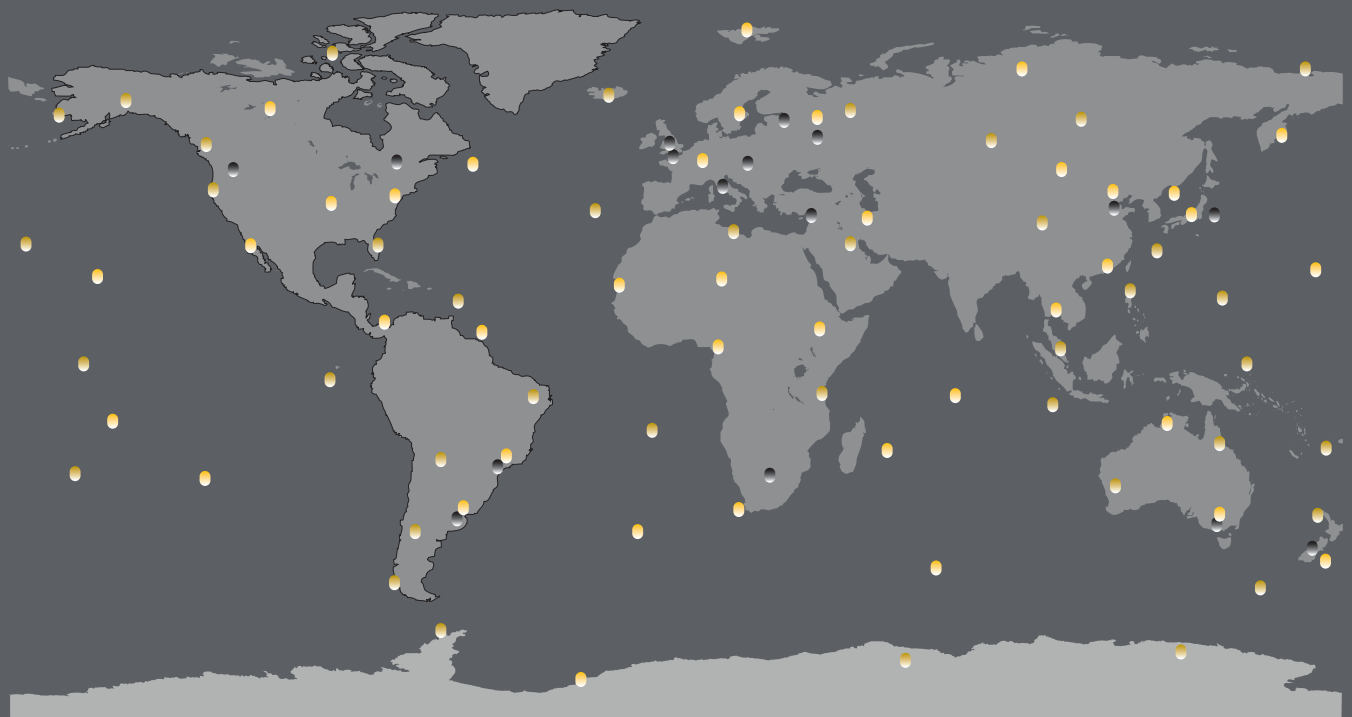
Radionuclide monitoring technology is complementary to the three waveform technologies employed in the Treaty verification regime. This is the only technology that is able to confirm whether an explosion detected and located by the waveform methods is indicative of a nuclear test. It provides the means 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.



80 stations and **16** laboratories in 41 countries,
with additional noble gas detection capabilities at 40 of the stations





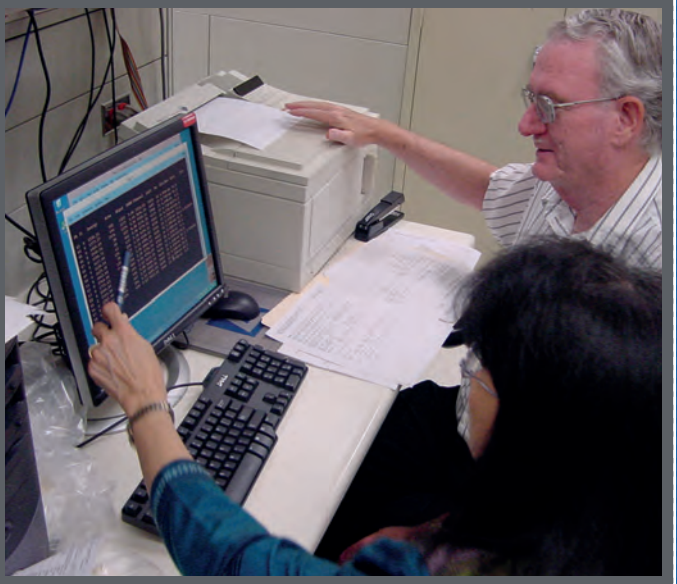
Noble Gas Detection Systems

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.

Radionuclides 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 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 gives an assurance that the results provided by a laboratory are accurate and valid. These laboratories also participate in the annual Proficiency Test Exercises organized by the Commission. In addition, certification of IMS radionuclide laboratories for noble gas analysis capability started in 2014.

The Global Communication Infrastructure teleport at Blåvand, Denmark

Highlights in 2014

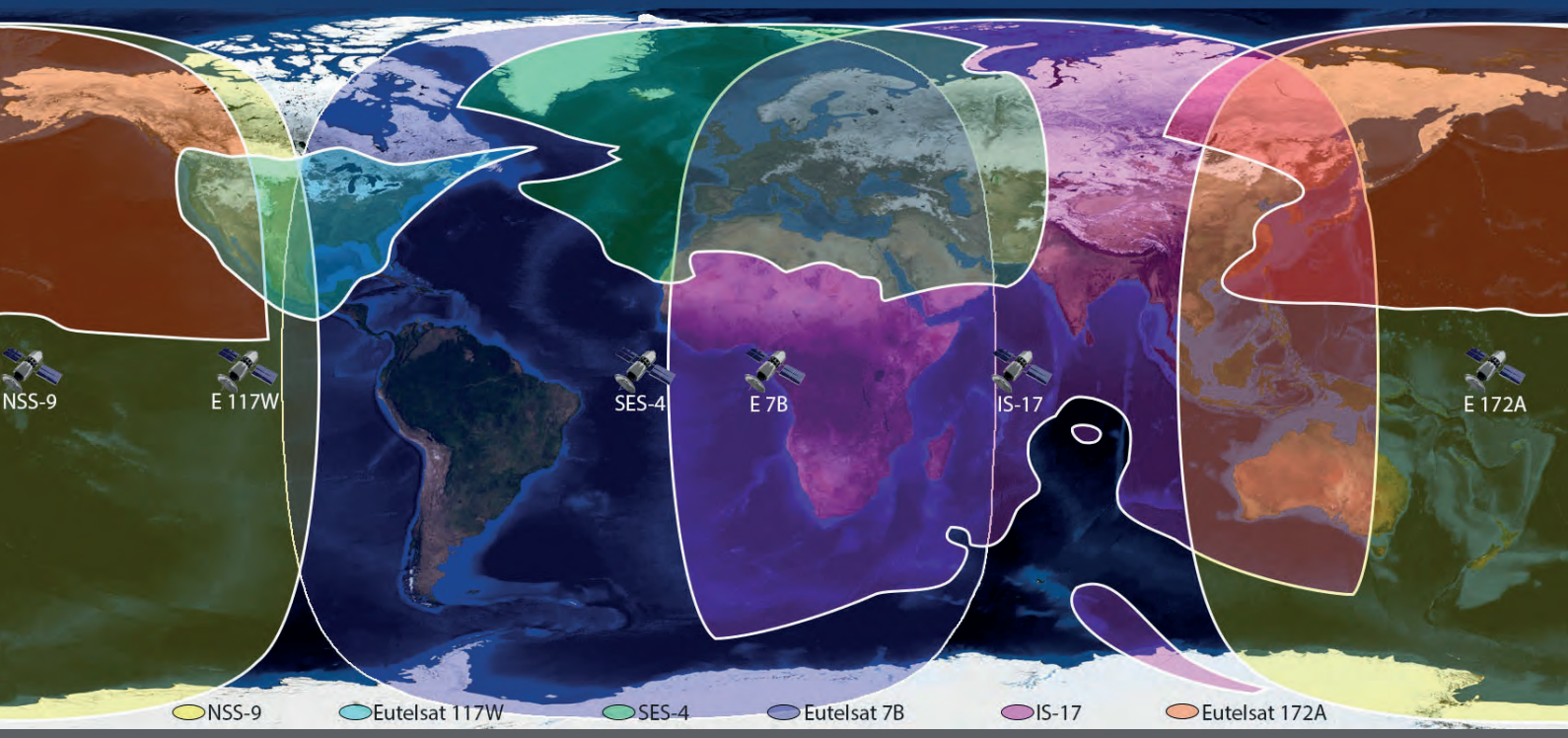
GCI availability maintained above 99.5%

Nearly 39 gigabytes of data and products transmitted per day

Teleports and terrestrial circuits migrated and consolidated

The Global Communications Infrastructure has two principal functions. First, it is designed to transport raw data from the 337 facilities of the International Monitoring System in near real time to the International Data Centre 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.

Operation of the current, second generation GCI began in 2007, under a new contractor. This replaced the first generation GCI, which began provisional operation in mid-1999. Using a combination of satellite and terrestrial communication links, this global network enables the exchange of data by IMS facilities and States around the world with the Commission. The satellite communication links of the GCI 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.

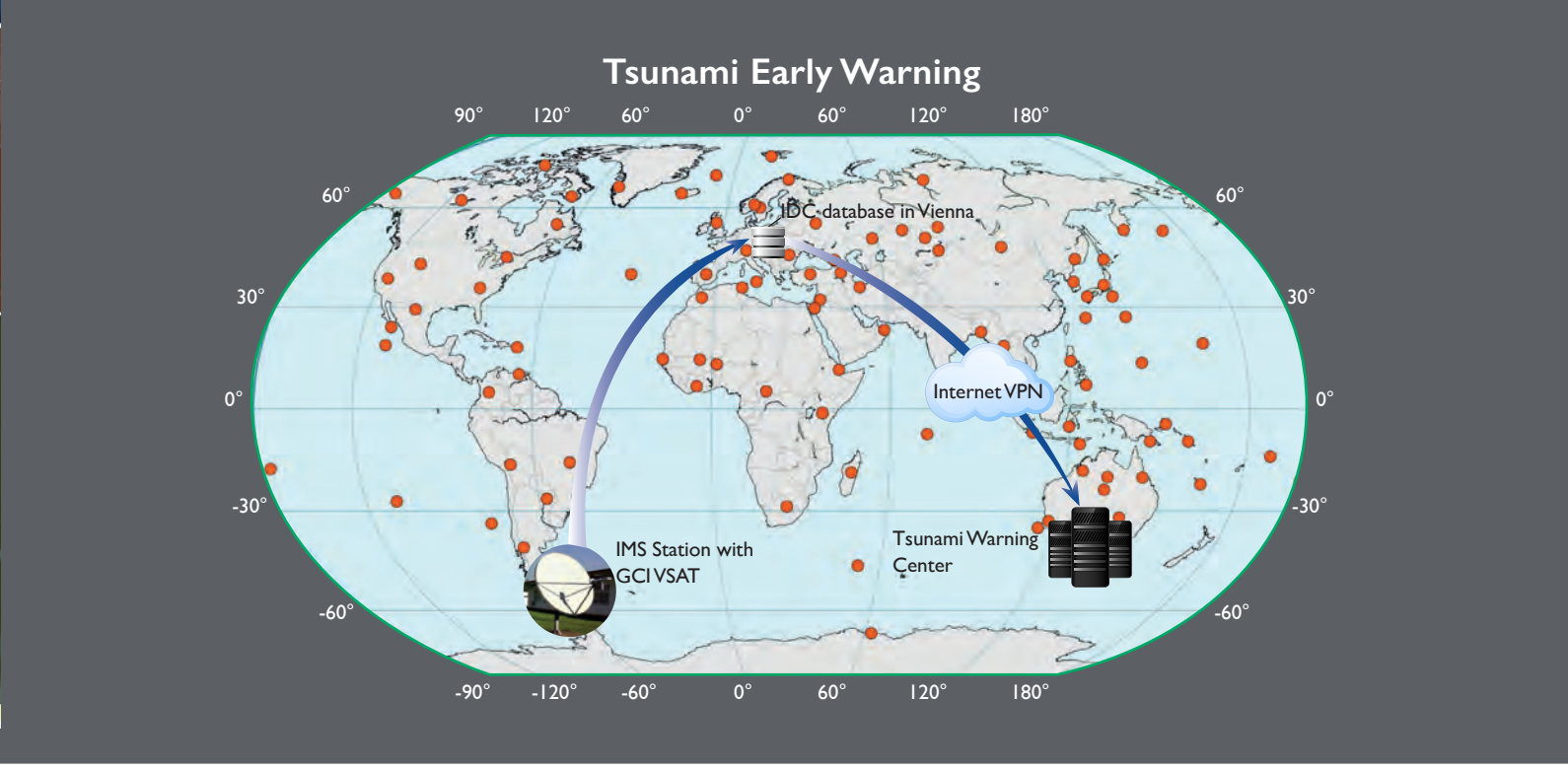


Technology

IMS facilities and States Signatories can exchange data through one of six geostationary satellites via their local earth stations fitted with a very small aperture terminal (VSAT). The six satellites cover all parts of the world other than those near the North and South Poles: three cover the Pacific, Atlantic and Indian Oceans and three focus on the North Pacific (Japan), North and Central America, and Europe and the Middle East. The satellites route the transmissions to hubs on the ground and the data are then sent to the IDC by terrestrial links. Complementing this network, independent subnetworks employ a variety of communications technologies to carry data from IMS facilities to a communications node connected to the GCI, from where the data are routed to the IDC.

A virtual private network (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. In situations where VSATs are still not in use or not operational, VPNs provide an alternative means of communication. VPNs are also used at some sites to provide a backup communication

Top: The footprints of the six geostationary satellites of the GCI
Middle: Communications equipment at infrasound station IS49, Tristan da Cunha, United Kingdom.
Bottom: Communications equipment at auxiliary seismic station AS110, Kodiak Island, Alaska, United States of America



Red dots indicate the IMS stations from which the Commission continuously forwards data, in near real time, to recognized tsunami warning organizations. IMS data arrives at the IDC over a GCI link and is forwarded to a tsunami warning organization over an Internet VPN connection.

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 2014 the GCI network included 217 VSAT stations (of which 26 had backup VPN links), 32 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, 3 satellite teleports (in Denmark, Norway and the USA) for the 6 geostationary satellites, and a network operations centre in Maryland, USA. All of these are managed by the GCI contractor. In addition, a total of 68 independent subnetwork links and 6 Antarctic communication links are operated by 10 States Signatories to carry IMS data to a GCI connection point. In all, the combined networks have nearly 330 different communication links to transport data to and from the IDC.

Expanding the Infrastructure

The use of the Internet in a secure manner to transport IMS data and IDC products continued in 2014. NDCs typically receive data and products in this way. While the installations slowed down somewhat due to a lack of personnel, it was still possible to deliver equipment to six NDC sites. The installations will be completed in 2015.

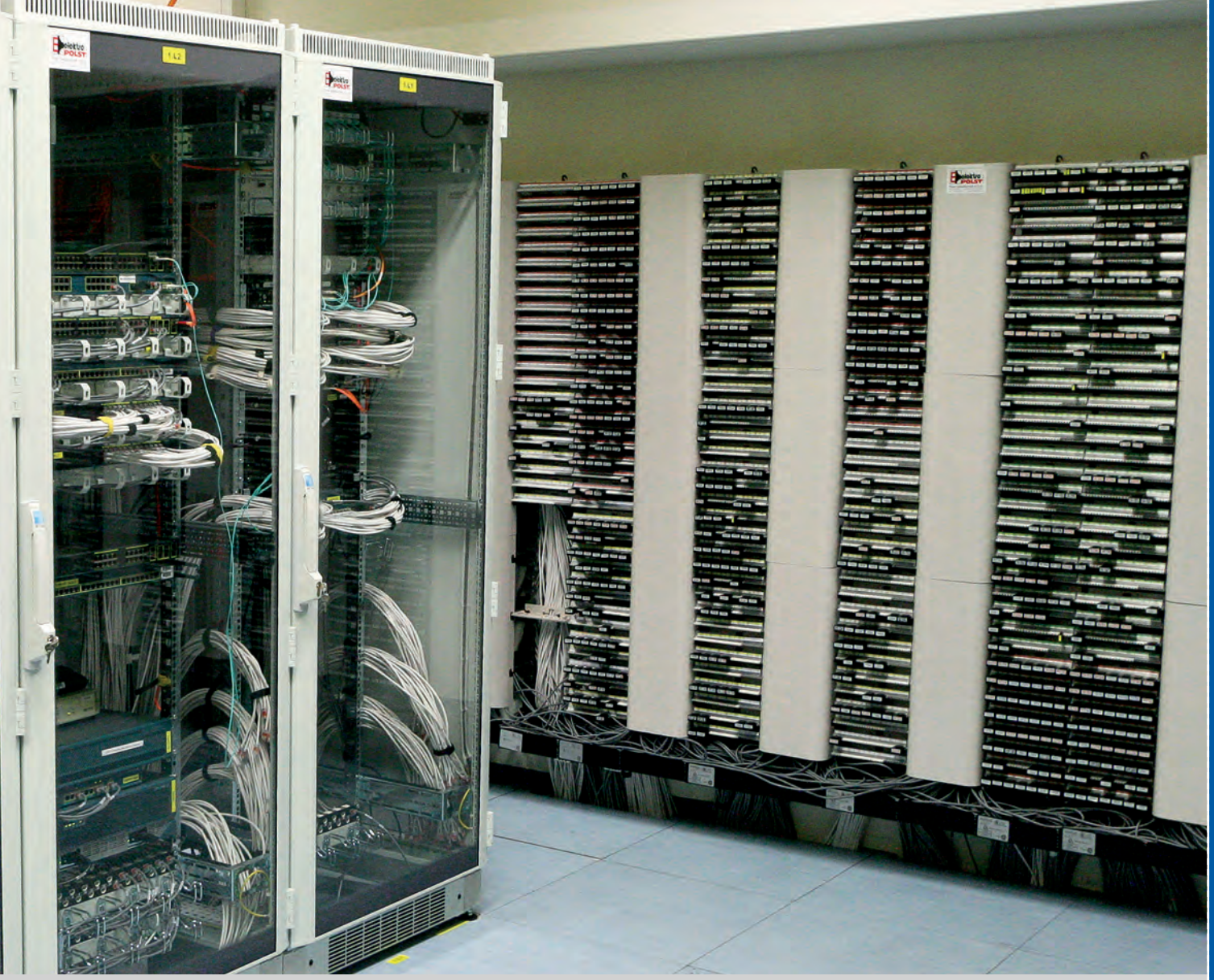
Operations

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 2014 this was above 99.5% in each month until November. The rolling 12 month actual availability, which is a measure of the raw uptime of each GCI link over one year, was about 1.8% lower than the adjusted availability. Over the year, there was a slight increase in the traffic transported over the GCI from IMS facilities to the IDC and from the IDC to NDCs to an aggregate of 29 gigabytes per day. In addition, data sent to NDCs that are directly connected to the IDC increased by 12%, to 9.8 gigabytes per day.

In 2014 the Commission made preparations to restore the communications for station AS112 on the island of Shemya, USA. In order to speed up the process, the initial solution will use an encrypted link over the Internet. A VSAT will subsequently be added to the site in a dual path mode. The GCI antennae (dual VSAT site) on Tristan da Cunha, which suffered damage to its radome in 2013, were replaced by high wind antennae.

The 2014 Integrated Field Exercise (IFE) used a primary telecommunications service known as GCI II. During the exercise, the light antenna GATR terminal provided the main link between the base of operations in Jordan and the Operations Support Centre (OSC) in Austria, for both data and voice communication.

Part of the VSAT service moved to a new teleport in 2014 in conjunction with an extensive modernization of the terrestrial backbone infrastructure link to the IDC. The satellites covering Europe and the Middle East and the Atlantic Ocean were migrated to a teleport at Blåvand, Denmark, from teleports in Norway and the USA, respectively. This major restructuring of the GCI network is intended to improve the reliability of GCI services at no cost to the PTS. The restructuring will be completed in 2015.



The International Data Centre computer centre

Highlights in 2014

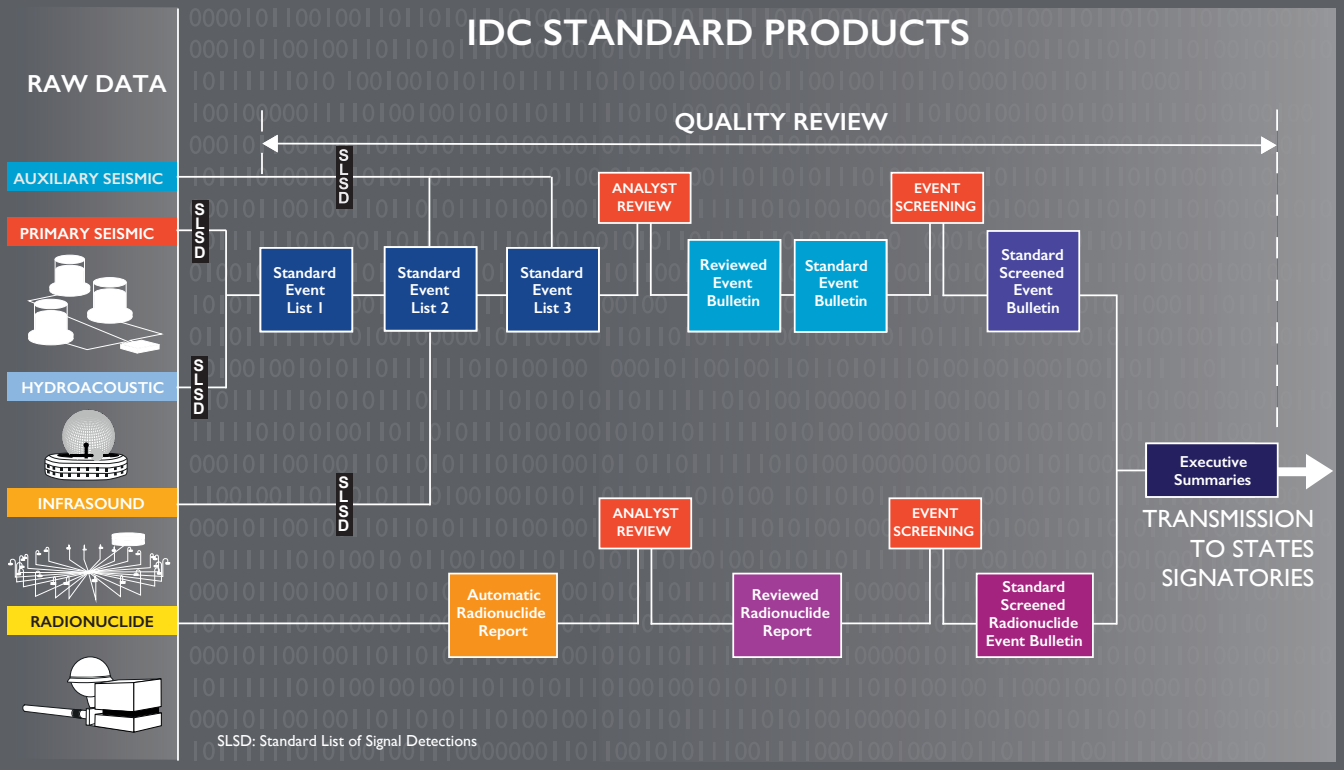
Requirements met for moving from Phase 5a to Phase 5b of the IDC Progressive Commissioning Plan

Implementation of Public Key Infrastructure at 61 facilities of the IMS

Porting to a new, more interactive data processing version of the Linux operating system

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

The Commission has created full network redundancy at the IDC in order 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 13 years. Most of the software used in operating the IDC has been developed specifically for the Treaty verification regime.



Operations: From Raw Data to Final Products

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

The IDC then requests data from the auxiliary seismic stations. The IDC uses these data, along with data from the infrasound stations and any waveform data that arrive late, to produce a more complete waveform event list, Standard Event List 2 (SEL2), four hours after first recording the data. 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.

Analysts subsequently review the waveform events recorded in SEL3 and correct the automated results as appropriate to generate the Reviewed Event Bulletin (REB). The REB for a given day contains all waveform events that meet specific quality 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.

Observations from events recorded by IMS radionuclide particulate and noble gas monitoring stations typically arrive several days later than the signals from the same events recorded by the seismic, hydroacoustic and infrasound stations. Radionuclide data undergo automatic processing to produce an Automatic Radionuclide Report (ARR). After review by an analyst, a Reviewed Radionuclide Report (RRR) is issued for each spectrum received.

The Commission performs atmospheric backtracking calculations daily for each of the IMS radionuclide stations with near real time meteorological data obtained from the European Centre for Medium-Range Weather Forecasts. 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 nine 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.

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.

Services

A National Data Centre is an organization in a State Signatory that has technical expertise in the Treaty verification technologies. Its functions may include receiving data and products from the IDC, processing data from the IMS and elsewhere, and providing technical advice to its national authority.

In 2014 the Commission continued to provide the 'NDC in a box' software package for use at NDCs, enabling them to receive, process and analyse IMS data. It provided additional functionality in the NDC in a box package that allows users to read and process waveform data in additional standard formats. This enables users to more easily combine data from the IMS network with data from local and national stations and from other global networks. With support from the European Union (EU) under Decision V of the Council of the EU, the Commission initiated a project to significantly extend the processing functionality delivered as part of the NDC in a box.

Build-up and Enhancement

IDC Commissioning and Data Surety

Build-up and enhancement of the IDC is essential to its commissioning. To be able to move from Phase 5a to Phase 5b of the IDC Progressive Commissioning Plan, the IDC had to ensure that formal security measures are in place to prevent external interference in or compromise of IDC operations and products and other facilities of the Commission. The IDC is implementing the necessary security measures.

The Commission continued to make steady progress in the implementation of the Public Key Infrastructure (PKI) in 2014. The PKI Portal, the facility used by PKI operators to submit certificate requests to the IDC, is now fully integrated with the single sign-on facility of the organization, and access is protected using two factor authentication. By the end of 2014 the Commission had implemented the PKI at 61 IMS facilities, thus exceeding the requirement to have 10% of IMS facilities (approximately 28 stations) signing authenticated data.

Security Improvements

The Commission continued to identify and evaluate risks to its operational environment and implement security measures to strengthen controls on information technology (IT) that safeguard its IT assets. These included mitigating risks of malware attacks and a 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 developed an awareness and training programme to educate staff on security best practices and to serve as a foundation for the introduction and implementation of organization-wide security policies. The training course 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 with a phased implementation of security best practices.

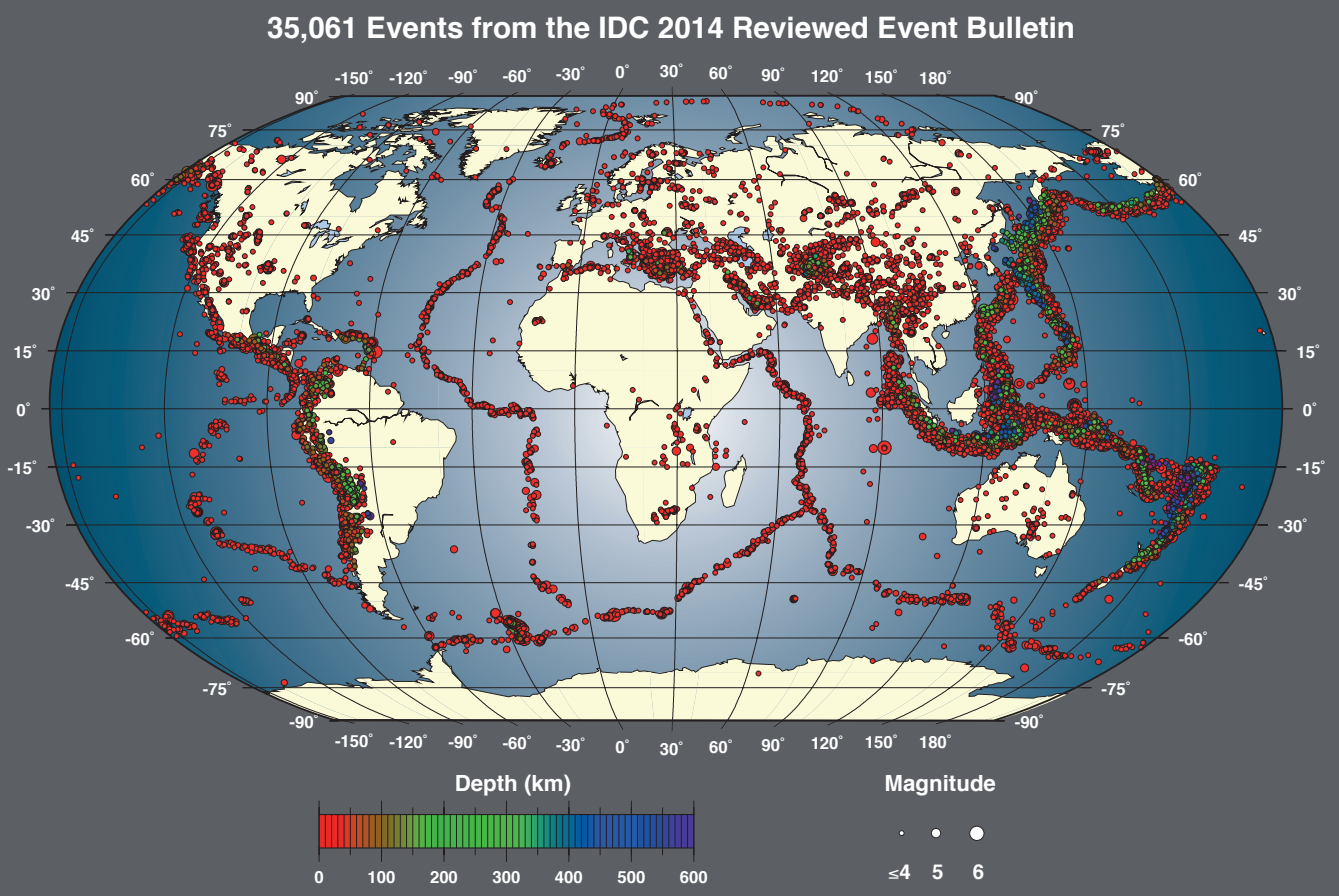
Hardware Enhancements

The Commission transferred the internal storage of atmospheric transport modelling (ATM) data to a SAM-FS cluster for flexibility and efficiency. At the same time, it conducted a pilot project to test the distribution of very large ATM data files via cloud storage in order to relieve the internal network infrastructure. A number of NDCs assisted with the pilot test.

Software Enhancements

As part of the Linux cluster migration project, the Commission ported all IDC software to a new version of the Linux operating system. The project required extensive testing of all software that is part of IDC operations. It was the first operating system version upgrade carried out since the migration from Solaris to Linux, completed in 2010.

The Commission continued to make progress in 2014 with the new regional seismic travel time (RSTT) software and model that have been provided as a contribution in kind by the United States of America. It derived travel time correction files for a total of 82 IMS seismic stations in Eurasia, North Africa and North America using the latest RSTT model. Relocation tests undertaken by the Commission and collaborators validated the projected improvement in location accuracy over using a single standard reference earth model. An integration test to verify operational performance in the IDC development environment was completed in 2013. In 2014 the Commission initiated an operational test to compare automatic processing results across all stages of the processing pipeline.



The Commission continued to develop new automatic and interactive software that uses state of the art machine learning and artificial intelligence. It enhanced the NET-VISA software to enable processing of hydroacoustic data in addition to seismic data. Testing NET-VISA at the IDC continued in 2014 and focused on determining the effect of running NET-VISA in all stages of the network processing pipeline. The Commission made additional efforts to change the network processing pipeline to merge seismic and hydroacoustic events produced by NET-VISA with infrasound events.

Following a multiyear collaboration with the NDCs of France (CEA) and Germany (BGR), the infrasound threshold monitoring software, known as DTK-NetPerf, was finalized and donated to the Commission. DTK-NetPerf models infrasound network performance by producing network threshold monitoring maps in near real time, taking into account state of the art frequency dependent attenuation relations, measured station background noise and accurate atmospheric specifications. The software supports both routine infrasound analysis and the sustainability effort of the IMS infrasound component in order to maintain a global infrasound detectability level that is sufficient for robust monitoring.

In June 2014 the Commission decommissioned the old message system that had been used to disseminate data and products to authorized users in States Signatories for more than 15 years. The decommissioning was preceded by the migration of all active subscriptions to the replacement, the verification data messaging system (VDMS). The Commission also released a new acquisition system in December. This system acquires and verifies data from radionuclide stations and segmented data from seismic auxiliary stations. It replaced the last component of the old message system that the IDC was using.

The organization upgraded the UniSampo Shaman software of the alternative radionuclide analysis system (ARAS) pipeline for particulates data and used it for regular benchmarking of the IDC software. Both the IDC and the ARAS pipelines processed a set of complex spectral data from samples affected by the nuclear accident at Fukushima, Japan, in 2011. A benchmarking report is being finalized.

In 2014 the Commission took delivery of a new version of the XECON software used for noble gas data processing. It intends to use XECON as a benchmarking system for beta–gamma coincidence based noble gas data, as part of the ARAS pipeline.

The Commission also implemented a new approach to the categorization of particulate samples in the IDC test bed. It completed extensive testing based on 10 years of detections and key natural nuclides.

Automatic calibration tools are integrated into the radionuclide pipeline for automatic update of the beta–gamma calibrations of noble gas data using two software tools, bg_analyze and Norfy. The Commission updated both software tools to support quality control based calibration in both automatic and interactive modes. The latest improvements include a robustness check against bad quality control data and fine-tuning the selection logic of calibration options. After extensive testing, the Commission will begin to use the tool in the tool to IDC operations for daily processing of data from certified noble gas systems.

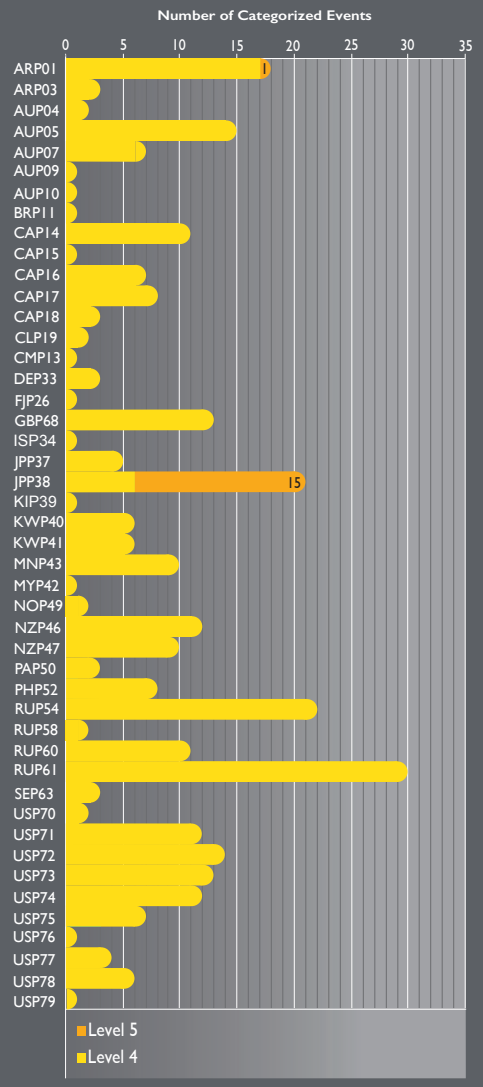
In 2014 the organization initiated a development project to implement a new approach to analysis of beta–gamma coincidence based noble gas data, known as the standard spectra method. It was successfully configured in the development environment based on Monte Carlo simulated reference spectra of the four xenon isotopes and radon interfering decay product.

The Commission tested a newly implemented two dimensional fitting method in the IDC development environment during 2014. This will provide a third option for processing beta–gamma based noble gas data, alongside the net count calculation and standard spectra methods. Testing on the second delivery, which includes interference corrections and new database tables, will continue.

The Commission continued to enhance its noble gas processing software during 2014. Changes included an update to the noble gas categorization scheme that allows detection of ^{131m}Xe to trigger category Level C for a sample and enhancements to the noble gas ARR and RRR to include xenon isotope-specific categorization parameters. The current XML-based report containing sample data and automatic processing results (SAMPML) was extended with interactive review results.

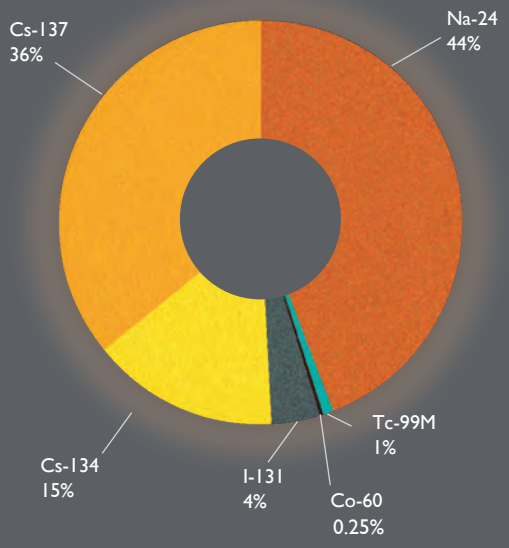
As part of the support provided to the 2014 Integrated Field Exercise, the Commission customized the radionuclide components of the NDC in a box software package to fit the technical and operational requirements for on-site inspection. This included changes to the radionuclide library, a new layout for the ARR and RRR for particulates, and creation of a new product that combines metadata and detection results for import into

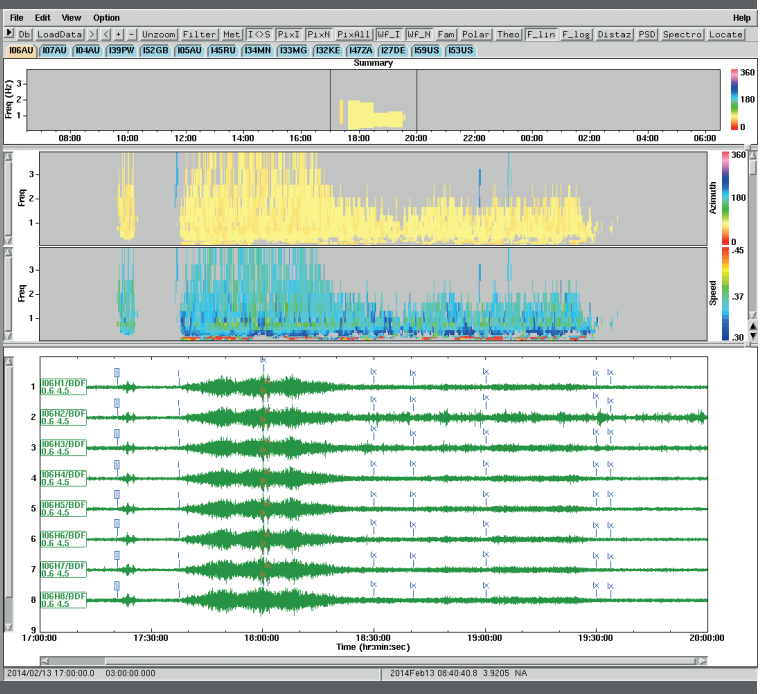
Radionuclide Events Recorded by IMS Stations in IDC Operations in 2014



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.

Treaty Relevant Radionuclides Detected in 2014





the OSI field information management system (FIMS). The Commission trained OSI inspectors on the radionuclide modules of the NDC in a box as part of a technical training event on radionuclides and noble gases in May 2014.

A new secure web portal for dissemination of IMS data and IDC products and documents to authorized users began operation at the beginning of 2014. This long-awaited replacement of the old web site, which runs on obsolete hardware, gained users during the year. The old site will be removed in 2015.

The organization initiated a second phase of IDC re-engineering in 2014. This project, carried out with support from a contribution in kind from the United States of America, aims to specify a unified architecture for all seismic, hydroacoustic and infrasound software, across processing stages, to pave the way for further development and future sustainment of the software. The design effort is intended to run until 2016. Experts from States Signatories reviewed the first deliverables at a technical meeting in Vienna in June 2014.

The International Noble Gas Experiment

Data from the 31 noble gas systems that are in provisional operation at IMS radionuclide stations continued to be sent to the IDC during 2014. The 22 certified systems and the 1 non-certified system that is in the process of certification sent data to IDC operations, while data from the remaining 8 non-certified systems were processed in the IDC testing environment. Significant efforts continued to be undertaken to ensure a high level of data availability at all systems through preventive and corrective maintenance and regular interaction with station operators and system manufacturers.

The background levels of xenon are currently measured at 32 locations as part of the International Noble Gas Experiment (INGE) but are still not understood in all cases. Medical isotope production facilities are the biggest contributor to background radioxenon. The expected increase in the number of plants producing medical isotopes will lead to an increase in the number of non-Treaty-relevant detections. This problem is compounded by the fact that the noble gas composition of the emissions from these plants can be similar to

Top: An artist's impression of a near earth object, such as the one that caused the airburst at Chelyabinsk, Russian Federation, in 2013
Middle: Mount Kelud, Java, Indonesia, in relation to the 14 infrasound stations that detected the eruption on 14 February 2014
Bottom: The volcanic eruption of Mount Kelud, as detected by infrasound station IS6, Cocos Islands, Australia

emissions from a nuclear explosion. A good understanding of the noble gas background is thus crucial for identification of signals from nuclear explosions.

An initiative funded by the EU (under Council Joint Action III and Decisions IV and V) to improve knowledge of the global radioxenon background, which started in December 2008, continued in 2014. The objectives of this project are to supplement knowledge on the global radioxenon background over longer periods. By performing measurements for at least six months, this project will provide more representative periods at selected sites, will detect local sources, if present, and will provide empirical data for validating network performance, for testing xenon equipment and logistics, for data analysis and for training local experts. Joint Action III and follow-up activities have explored how radiopharmaceutical facilities affect Treaty related noble gas analysis and will improve understanding of the global radioxenon inventory. The data and subsequent analysis will help the Commission to better interpret its observations and to differentiate between Treaty-relevant events and normal background events.

To continue this important work, EU Council Decision V supported a two year project that began in December 2012 to further measure the noble gas background and test remediation efforts. This work was also supported by a contribution in kind from the United States of America, through which the Pacific Northwest National Laboratory conducted background measurements, using an additional portable detection system, and supports facility monitoring and remediation tests. Following the end of Joint Action III, the Commission continued to operate the mobile noble gas monitoring systems in Japan and Kuwait. The system deployed at Takasaki, Japan, served as a backup for the noble gas system at the radionuclide station RN38 at Takasaki while that facility underwent maintenance. In July 2014 the system was relocated to Mutsu, Japan, for a short term regional background measurement campaign. At the end of 2014 the system was deployed to Manado, Indonesia. The Commission plans to use the results and conclusions drawn from this campaign to further develop the noble gas categorization scheme and to gain a better understanding of the inventory, transport and time variation of radioxenon in the atmosphere.

EU Council Decision V also funds a project on mitigation of emissions of radioxenon from medical isotope production facilities. Under this project, the Commission is developing a xenon filtration system with the aim of reducing emissions from medical isotope production. The organization finalized the design of a prototype filtration system in 2014 and will test a first prototype system in 2015.

An additional radiopharmaceuticals producer, NorthStar Medical Radioisotopes LLC, pledged in 2014 to help the Commission mitigate the effects of radioxenon emissions by reducing emissions, sharing stack monitoring data and continuing to collaborate with the community connected to the Workshop on Signatures of Medical and Industrial Isotope Production.

Civic Activities

Provision of Data for Tsunami Early Warning

In November 2006 the Commission endorsed a recommendation to provide continuous IMS data in 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 (UNESCO) to provide data for tsunami warning purposes. In 2014 the Commission finalized agreements with the National Earthquake Data Centre of the Department of Meteorology and Hydrology, Myanmar, and the Institute of Geodynamics of the National Observatory of Athens, Greece. Such agreements or arrangements have now been made with 14 organizations, in Australia, France, Greece, Indonesia, Japan, Malaysia, Myanmar, the Philippines, the Republic of Korea, the Russian Federation, Thailand, Turkey and the United States of America (Alaska and Hawaii).

As a consequence of the 2013 airburst in Chelyabinsk, Russian Federation, infrasound technology continued to attract interest in 2014 beyond the verification regime. In particular, the United Nations Committee on the Peaceful Uses of Outer Space and the B612 Foundation expressed interest in its use for studying near earth objects. IMS infrasound data and IDC products can provide valuable information on a global scale regarding bodies entering the atmosphere.

The eruption on 14 February 2014 of the volcano Kelud on Java, Indonesia, was the largest-ever eruption detected by infrasound stations associated with the IMS. Fourteen stations recorded the event, at distances of up to 11 000 kilometres: IS4, IS5, IS6 and IS7 in Australia, IS27 in Antarctica, IS32 in Kenya, IS33 in Madagascar, IS34 in Mongolia, IS39 in Palau, IS45 in the Russian Federation, IS47 in South Africa, IS52 in the Chagos

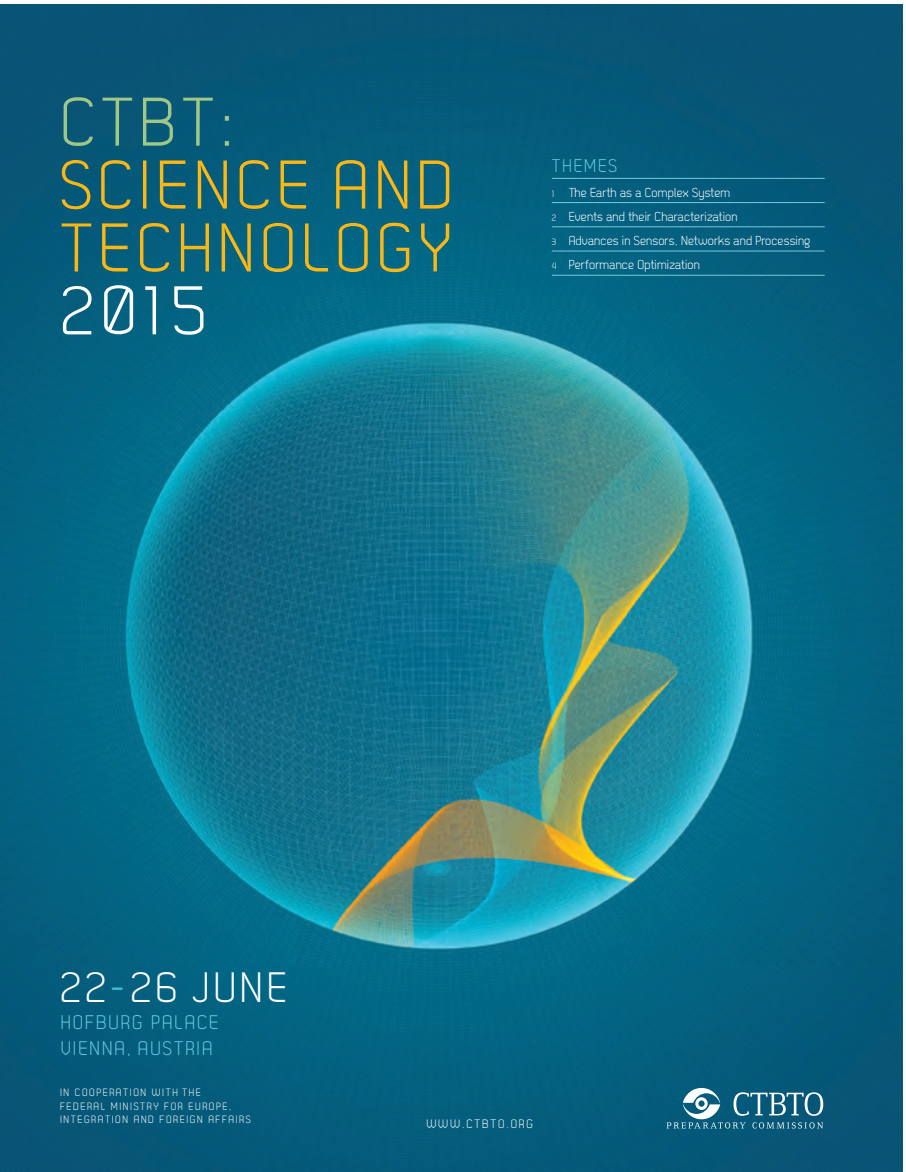
Archipelago, British Indian Ocean Territory, and IS53 and IS59 in the USA. Volcanic ash clouds can be hazardous for air traffic, as the ash may clog jet engines. The Commission is collaborating with the scientific community of the Volcanic Ash Advisory Centres (VAACs) and the Atmospheric dynamics Research InfraStructure in Europe (ARISE) project to develop an infrasound volcanic notification system.

The CTBT: Science and Technology 2015 Conference

To keep abreast of scientific developments, the Treaty verification regime relies on the latest advances 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 community engaged in aspects of test-ban monitoring: detecting, locating and identifying nuclear explosions. 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 required improvements in the verification regime benefit from cutting edge research.

Previous CTBT: Science and Technology conferences organized by the Commission form part of this innovative process and have become an intrinsic part of the activities of the organization. A significant share of the work of the Commission continues to be the exploring of new and improved verification methods and the implementation of projects introduced at previous conferences to advance the capabilities of the verification system. For example, the Commission is following up on projects such as the new MB3 self-calibrating microbarometer, an optical seismometer, network performance tools, waveform association routines and cross-correlation techniques.

The Commission initiated preparations for the CTBT: Science and Technology 2015 conference in 2014. In particular, it finalized the objectives, themes, date and venue of the conference. The conference aims at enlarging the scientific community engaged in test-ban monitoring; promoting the wider scientific application of data that are used for test-ban verification; and enhancing the exchange of knowledge and ideas between the Commission and the broader scientific community.



The 2015 conference includes a new theme – performance optimization – in addition to the themes of the earth as a complex system, events and their characterization, and advances in sensors, networks and processing. As in the past, the conference is expected to attract a high number of oral and poster presentations on the four themes from scientists around the world, including some from non-signatory States. A dedicated webpage provides information on the conference, including registration, abstract submission and conference materials.

An inspector searches for evidence of a nuclear explosion during the 2014 Integrated Field Exercise

Highlights in 2014

Conduct of the 2014 Integrated Field Exercise

Completion of a project on noble gas systems and multispectral imaging

Conduct of training in radionuclides and noble gases for surrogate inspectors and final training for participants in the Integrated Field Exercise

The Treaty verification system monitors the world for evidence of a nuclear explosion. If such evidence were to be detected, concerns about possible non-compliance with the Treaty could be addressed through a consultation and clarification process. After the Treaty's entry into force, States could also request an on-site inspection, 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 could be invoked by any State Party at any time, the capability to conduct such an inspection requires development of policies and procedures and validation of inspection techniques to be completed before the Treaty enters into force. In addition, OSIs require adequately trained personnel, appropriate logistics and approved equipment 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.

Policy Planning and Operations

Policy planning and operations activities during 2014 focused on the final preparations for the Integrated Field Exercise. This included the refinement of a limited number of key projects related to OSI operations to take into account lessons obtained from the third build-up exercise (BUE III). After the IFE was completed, in December, the Commission immediately initiated follow-up activities.

As one of its key projects, the Commission embarked on the further refinement of the inspection team functionality (ITF) concept. It produced a revised practical guidance document in the form of a manual. It also prepared a standard operating procedure (SOP) for field team functionality (FTF), covering the preparation of field teams and the activities to be performed before starting field missions and on return to the base of operations. The ITF and FTF concepts were used in the planning of the final IFE training in June 2014 and applied during the course of the IFE.

The Commission also used the ITF and FTF concepts in the ongoing development of the integrated information management system (IIMS) and the field information management system. Taking into account lessons learned from BUE III, the organization proceeded with work on the new custom designed application of the geographical information system (GIS) and made improvements to the IIMS. Joint testing of the IIMS and the FIMS was carried out in March involving personnel designated as having an inspection team leadership role in the IFE in order to evaluate the GIS solution and the integration of the IIMS with the FIMS. Both the IIMS and the FIMS were heavily used during the IFE and valuable lessons were drawn for their further improvement.

To follow up on the lessons learned during the three BUEs on the Operations Support Centre, the Commission revised and finalized the Quality Management System (QMS) documentation and purchased related equipment. In addition, it made major progress in the development of OSI confidentiality procedures. On the basis of recommendations made during an expert meeting in January 2014, the Commission prepared an SOP for protecting and handling confidential information during an OSI. It also developed detailed guidelines for classification of OSI related information and data and reviewed them at an expert meeting in Vienna in September for personnel designated as confidentiality officers within the OSC and inspection team in the IFE. All these improvements underwent a final test during the OSC preparatory training that took place at the Equipment Storage and Maintenance Facility (ESMF) later in September.

As part of the final preparatory activities for the IFE, the Commission organized a high level meeting in Amman in March 2014, at which the project management team of the Secretariat met with senior representatives of the planning team of the host State. Members of the project management team visited Jordan again later in March and in June to monitor site preparations and finalize various logistical and host State support arrangements. In total, the Commission and the host State concluded four implementing arrangements to facilitate the conduct of the IFE.

To prepare for the 2014 IFE, the scenario task force members gathered five times in 2014. Two meetings were held in Vienna, in February and August. Radionuclide experts of the scenario task force also met in April 2014 at the Pacific Northwest National Laboratory, United States of America, for a coordination meeting. Members of the scenario task force representing all inspection technologies met in May 2014 at the Sandia National Laboratory, USA, to finalize the preparation of data products for the exercise and a guidebook for the IFE control team. This document included all of the required background information for the scenario, including information on potential injects – specially designed technical or procedural elements that may be introduced to ensure that the exercise stays within the designed scenario and envisaged timetable. In addition, the Commission developed an exercise timeline with important scenario implementation milestones for the control team documentation. In June key task force members participated in a site monitoring visit in Jordan to ensure that the site modifications met the scenario expectations.

The Commission organized a dress rehearsal in Jordan in September for host State representatives and key Secretariat staff designated as having an inspected State Party role in the IFE. The aim was to familiarize these participants with the exercise. All participants toured the inspection area, visited sites of interest and were briefed by members of the scenario team. In addition, a table-top exercise was carried out in order to familiarize those assigned to the inspected State Party, the control team and exercise management with the daily interaction mechanism that was to be implemented during the IFE.

As soon as the IFE ended, in December, the Commission initiated post-exercise activities. These included

immediate follow-up activities on administrative arrangements, including preparation of the final invoice for the exercise conduct, issuance of an online feedback form to all participants to identify lessons learned in the exercise and production of a documentary on the IFE.

Operations Support and Logistics

Logistics and operations support focused on three areas in 2014: efforts to finalize the implementation of the Integrated Inspection Support System; equipment preparation, modularization and transportation for the IFE; and initiatives to provide efficient and effective real time logistics and operations support for IFE training events and for the IFE itself.

On the basis of lessons identified during the series of BUEs and the IFE preparatory training activities, the Commission performed a broad documentation review in order to revise SOPs and other documents related to logistics, and to develop various detailed work instructions (WINs) to cover new equipment and processes. It paid special attention to the documentation related to health, safety and security.

The Commission finalized requirements for host State support, logistics support, and security, health and safety for the IFE and discussed them with the Jordanian authorities. The necessary contracting and logistics arrangements were implemented in both Austria and Jordan in order to provide full scale support for all IFE related activities in both locations. The Commission organized commercial logistics, transportation, material handling and storage services, which were subsequently performed according to the actual requirements of the exercise.

Activities at the ESMF focused on the integration and configuration of newly developed technical capabilities, such as radionuclide laboratory equipment and noble gas sampling kits, along with preparation and modularization of equipment. The Commission also took steps to further improve standardization and configuration management for scientific equipment and to ensure that sufficient stocks of spares and consumables are maintained, packed alongside the equipment modules. More than 60 tonnes of equipment provided as contributions in kind for the

Top: A briefing by OSC personnel during the IFE launch phase
Middle: The OSC planning team training for the IFE
Bottom: Preparations for the IFE at the ESMF

IFE were successfully received and integrated into the Intermodal Rapid Deployment System at the ESMF.

The Commission linked the inspection planning module of the OSI databank with the ESMF inspection equipment database, enabling its use for the selection of equipment and preparation of the inspection mandate during the inspection planning phase. The Commission reorganized the inspection equipment database structure to allow better reporting and easier information sharing with multiple applications. It also reviewed, developed and tested supporting documentation for point of entry check activities during the IFE preparatory training. To help the inspection team make better use of the inspection equipment database to track field equipment during the 2014 IFE, the organization implemented new procedures for the issuing and receipt of reports and equipment.

The Commission continued to develop and enhance OSI operations support, focusing mainly on the OSC and the OSI databank. It reviewed the lessons identified during the BUEs and made changes to procedures and infrastructure. A supporting group of technical specialists streamlined and enhanced the structure of the OSC. During the IFE preparatory training, the Commission applied new visualization tools and daily procedures for the exchange of information between the inspection team, the OSC and Secretariat management and new provisional procedures related to OSI confidentiality. These were covered further during OSC training in September 2014.

Training

The OSI training activities during 2014 addressed mainly the preparations for the IFE, through conducting relevant training courses, developing supportive e-modules, providing data and information, and participating as players in the exercise.

After the host State training in December 2013, the first training activity of 2014 took place in March in Romhány, Hungary, where deep continuation period techniques (CPTs), field testing and training activities were conducted. The objective of the event was to familiarize surrogate inspectors from the CPT sub-team with the active seismic and electromagnetic equipment to be used during the 2014 IFE. It also provided the opportunity

Top: Developing navigation skills during IFE training
Middle: Practising negotiation skills during IFE training
Bottom: Radionuclide and noble gas training for the IFE

to consider resonance phenomena at a basic level. Six trainees from six States Signatories were selected on the basis of their future roles in the IFE. The training was facilitated by three Secretariat staff members, an external facilitator from Hungary and a team of Hungarian geophysics experts.

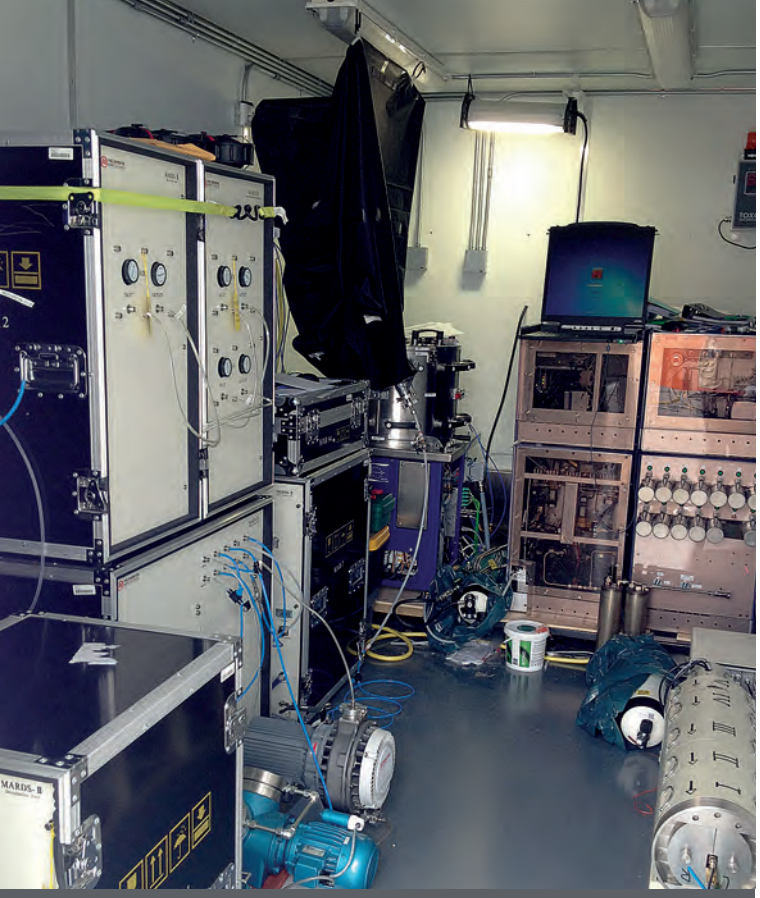
Radionuclide and noble gas (RN/NG) training was held in May 2014 at the ESMF. The objective of the training was to prepare surrogate inspectors from the RN/NG sub-team to perform their duties in the IFE, using the equipment available for the exercise. The participants were selected from the roster of surrogate inspectors from the first and second training cycles, based on their expected participation in the IFE. There were 19 trainees, from 14 States Signatories and the Secretariat. The training was facilitated by 19 Secretariat staff members and by 13 external facilitators from 6 States Signatories.

The preparatory training course for the 2014 IFE was held in June 2014 at the ESMF. The primary objective of the training was to prepare trainees to perform their duties within an OSI context during the IFE. The duties incorporate such elements as the IIMS, the FIMS and the ITF, as well as interactions between the inspection team and the inspected State Party. The 78 trainees that attended the course represented 40 States Signatories and the Secretariat. The training was facilitated and supported by 25 Secretariat staff members and by 11 external facilitators from 5 States Signatories.

During 2014 the Commission finalized and made available two e-learning modules – on the IIMS and on health and safety – applicable to an on-site inspection. Such e-learning tools will greatly assist surrogate inspectors both to prepare for subsequent training and to refresh knowledge and skills already acquired.

To consolidate information on surrogate inspectors into a single OSI Divisional database, external developers modified the structure of the existing OSI databank to accept data held in the OSI Rapid Inspector Selection (OSIRIS) database of the Training Section. The OSIRIS data was then updated, checked, 'cleaned' and migrated to the OSI databank. The Commission used this expanded databank during the IFE to generate the list of inspectors for the exercise, demonstrating the importance of having complete, accurate and accessible information.

Top: Electrical conductivity measurements during deep CPT training
Middle: The OSC communicating with the inspection team during the IFE
Bottom: Practising decontamination procedures during IFE training



The effective functioning of an inspection team relies heavily on the supportive role of an OSC. For that purpose, the Commission conducted a comprehensive training programme in September 2014 to train participants to fully understand and effectively play their roles in the OSC during the IFE. In total, 54 participants, including 47 Secretariat staff and 7 external participants from 4 States Signatories, received training on the functioning of the OSC, the outputs expected of the different OSC teams and the synergies between them. The training also covered requirements of the individual functions within the teams, as well as confidentiality and security.

Throughout the conduct of the IFE, the Commission ensured that the OSC was staffed full time. Operating a two shift rota, the Centre provided operational, administrative, security and communications support to the exercise. It also participated in drafting daily reports, and security details.

Techniques and Equipment

With the completion of the OSI Action Plan, the development of OSI techniques and equipment in 2014 focused on the preparation and conduct of the IFE. All equipment and supplies that were still required for the use of the permitted inspection techniques during the exercise (other than resonance seismometry and drilling) were either procured or received in time as contributions in kind.

The Commission undertook testing of and training with the equipment upon its arrival at the OSI technology laboratory in the ESMF, giving due attention to the integration of the different techniques and methods in line with the inspection data flow concept. For this, the organization made considerable efforts to finalize any technique specific guidance such as manuals, SOPs, WINs and checklists. Support for this was received from external experts as contributions in kind.

During the second half of 2014, activities concentrated on readying the equipment for the IFE by undertaking final functionality tests and subsequent packing. All required equipment was shipped to Jordan and was made available to the IFE inspection team. Only a few problems were

Top: SAUNA and MARDS noble gas systems in a transportable OSI laboratory container
Middle: Inspection equipment ready for transport at the ESMF
Bottom: An XESPM noble gas system in a transportable OSI laboratory container

noted during operations, none of which was critical to the fulfilment of the inspection, and the vast majority of the equipment operated as expected. In parallel to the preparation for and conduct of the IFE, the Commission gave attention in 2014 to improving capabilities for post-exercise equipment maintenance and technical support.

Following up on lessons identified during the BUEs, the Commission further improved the data flow within the IIMS for all inspection techniques. These are data from visual observation including multispectral imaging and measurement of radioactivity and radionuclides and noble gases, from passive seismological monitoring, and from continuation period techniques. As a result, a set of newly developed electronic forms for the recording of metadata of all these techniques was fully integrated into the IIMS, which has been designed to facilitate the ITF. The forms allow information from the inspection team planning process to be linked with information and data obtained in the inspection area. For visual observation, the form also provides for the joint review, with the inspected State Party, of photographs and other imagery, while the forms for environmental sampling and analyses are linked to the chain of custody part of the IIMS. The improved data flow and integrated electronic forms within the IIMS were intensively used during the IFE.

In order to ease the deployment of the well developed visual observation equipment and to facilitate the management of resources during the IFE, the Commission reconfigured the visual observation pod together with the relevant containers and replaced containers with backpacks. It also made further progress in relation to the developing multispectral imaging including infrared (MSIR) capabilities. Together with remote sensing equipment provided by Hungary as a contribution in kind, the Commission integrated its MSIR system with airborne gamma detection equipment during a mounting test in an airframe provided by the Royal Jordanian Air Force in Amman in March 2014. This test resulted in the airworthiness certification of both systems and also served as a final functionality test of the MSIR system. The system was successfully deployed during the IFE, marking the first ever use of such technology in an exercise by the organization. Moreover, for the first time the Commission's pilot navigation system was used for all overflights during the IFE, enabling inspectors to monitor overflight progress and adherence to flight plan and parameters.

Concerning passive seismological monitoring, the IFE training in 2014 for surrogate inspectors used a seismic data set from the earthquakes in Ebreichsdorf, Austria, in October 2013 that had been acquired with the Seismic Aftershock Monitoring System (SAMS). The data set provided SAMS trainees with real data on small scale natural aftershocks for data processing and identification of OSI-relevant signatures. The Commission also prepared a new SAMS data centre virtual machine as part of the working area IIMS, where updated versions of the NanoseismicSuite software and the Geotool package were installed. SAMS, including the newly developed, tested and integrated data flow between SAMS and the IIMS, was fully operational and used during the IFE. This allowed faster and more streamlined preprocessing of recorded seismograms.

In time for the 2014 IFE, the Commission finalized the configuration and set-up of the new radionuclide field laboratory, which was tested as a prototype during previous build-up exercises. The improvements, which were based on the lessons learned, included specific calibrations of the detectors for appropriate field sample geometries, liquid nitrogen-free cooling technologies and a new design for the transportable lead shielding. They also involved client server configuration for the acquisition of spectra, as well as streamlined chain of custody and data flow, including results and metadata through the IIMS and the FIMS.

The OSI noble gas system SAUNA, funded by the European Union, was delivered to the ESMF in early 2014. A one week in-depth training in February was undertaken for four Secretariat noble gas experts. The Commission integrated the system into one of the two noble gas laboratory containers that were provided for the IFE as a contribution in kind by the United States of America along with the transportable xenon laboratory (which was used to continuously monitor local background data for the base of operations during the exercise).

The SAUNA system was tested over several months before final approval. The two noble gas systems provided by China as a contribution in kind for the IFE (MARDS for ^{37}Ar detections and XESPM for xenon detections) were shipped to the ESMF. In March the developers of the systems provided set-up testing and training of Secretariat experts and integrated the individual systems into the noble gas laboratory containers.

A benchmarking functionality test in April represented the culmination of more than two years of intense noble gas developments in laboratory and field equipment, methodology and operational concepts. The noble gas laboratory operations, individual system performance,

system interfaces and scheduling were scrutinized during this test. The capability of the noble gas laboratory, best practice for field operations, and all technical aspects for effective noble gas sampling and analysis during the IFE were also discussed.

Coordinated by the Commission, the joint efforts of the international group of noble gas experts resulted in the following achievements:

- A mobile noble gas laboratory for field deployment that is capable of measuring ^{37}Ar and xenon isotopes from the same sample of either subsoil gas or atmospheric air with all systems running simultaneously;
- The mobile noble gas laboratory being capable of running gas samples from OSI sample containers and spiked with ^{37}Ar, xenon or gas impurities;
- The Commission being ready for routine deployment of a complete set of field sampling equipment for unattended subsoil gas sampling, including an augering machine capable of reaching depths of 10 metres below ground and smart samplers with integrated environmental monitoring and tampering logging;
- The testing of routine operations for noble gas detection during an OSI and review of mobile laboratory best practices.

The Commission tested a commercial off the shelf silicon PIN diode beta–gamma detector (from the Russian Federation). After further upgrades and adaptation to the requirements of the OSI noble gas laboratory, it was purchased in order to support the XESPM, which does not have its own detector system. In addition, Sweden provided, as a contribution in kind, noble gas preprocessing equipment for removal of impurities such as carbon dioxide from raw samples, since past technical field tests identified this as being required. The Commission prepared all the individual kits for the IFE subsoil gas sampling equipment for the field by end of August, based on outcomes from noble gas field tests in 2011–2013 and the experience of all noble gas related events in 2014. It concatenated and tested all noble gas software for data analysis and evaluation and installed it on a series of laptops going to the IFE. This supported the noble gas laboratory as well as noble gas game play via the surrogate inspected State Party and the control team.

The Commission continued its contract with the University of Bern, Switzerland, to further the scientific understanding of selected noble gases and enlarge ^{37}Ar data sets from different locations and botzh subsoil gas and atmospheric air (from both the troposphere and the atmosphere). The complex analysis and evaluation of the data is at the boundary of current research and will continue in 2015 as more data arrive from the newly installed sampling sites. In this context, the Commission's young scientist award, funded by the EU, was given to a project focusing on the numerical modelling of ^{37}Ar transport and background in various soil types, which is a crucial complement of the ^{37}Ar project with the University of Bern. The Commission also continued its technical cooperation with other organizations in the field of noble gas monitoring through contributions by Secretariat experts to the International Atomic Energy Agency (IAEA) Symposium on International Safeguards: Linking Strategy, Implementation and People.

A field test and training on OSI continuation period techniques took place in Hungary in March 2014. The test intended to familiarize IFE participants with selected equipment for deep ranging geophysical methods provided as contributions in kind. The activity also aimed to prepare surrogate inspectors from the CPT sub-team to use active seismic and deep electromagnetic equipment. Both active seismics (for the first time in the OSI context) and deep electromagnetics were used effectively during the IFE. This provides the basis for further development of the CPT programme.

Documentation and Procedures

Activities related to documentation and procedures development during 2014 involved support to Working Group B (WGB) of the Commission and finalization of a set of OSI standard operating procedures, work instructions, other Quality Management System documents and the OSI e-library for the IFE. The Commission completed a series of documents related to preparations for the IFE. The subjects covered included extracting of forms and templates, compiling of equipment and software user manuals, and printing of field versions of IFE documentation. In addition, preparations for OSI Workshop-22 started.

The Secretariat provided substantive technical and administrative assistance to WGB during its third round

of elaboration of the draft OSI Operational Manual at its Forty-Second and Forty-Third Sessions and in the interim period.

Development of a set of OSI specific documents for the IFE continued in the first half of the year. A large number of draft SOPs, WINs and manuals were submitted by mid-March 2014 for formal review and approval in line with QMS document procedures. Most of these draft documents were reviewed by experts with specific OSI expertise. The issues raised during the review process were discussed at an expert meeting in Vienna in April 2014 with involvement of document process owners, writers, reviewers and focal points in the Commission. By late May 2014, of the 83 QMS documents submitted, 48 had been reviewed and approved and the remaining 35 remained as drafts authorized for use during the IFE.

The full set of QMS documents for the 2014 IFE was then prepared and made available for trainers and trainees before the IFE preparatory training course in June. During the course, trainees had an opportunity to use these approved and authorized documents. Also, more than 20 approved or authorized versions of SOPs and WINs on radionuclides and noble gases were made available for trainers and trainees before the RN/NG training course for the IFE in May (see above).

In addition to the QMS documents, about 200 forms and templates extracted from approved or authorized QMS documents were prepared for the IFE. More than 500 equipment and software user manuals covering 15 of the 17 OSI techniques under the Treaty as well as academic and scientific material were also compiled and organized by OSI topic code for use during the exercise.

The OSI e-library went into operation on 6 June 2014. It was populated with more than 1500 documents for the IFE. The e-library was interfaced with the QMS document management system, ensuring automatic replication of all approved OSI QMS documents to the OSI e-library. It was also interfaced with the IIMS for use in the field. The system offers useful search functionality and allows for the creation of electronic packages of search results (so called e-kits) for offline use at headquarters and also in the field on tablet computers.

In addition to the e-library, the field library concept was introduced. It provided robust booklet versions of all OSI QMS documents and the draft OSI Operational Manual, colour-coded by topic, on a revolving display stand for reference at the base of operations, receiving area and inspection team office during the IFE, and at the OSC at the ESMF.

The Commission designed and printed inspector notepads for use by IFE participants, as well as booklets containing exercise information for specific participants groups. Additional e-book readers that included a full set of IFE documentation were also prepared for use by inspectors at living quarters during the exercise.

Conduct of the 2014 Integrated Field Exercise

After almost three years of intense preparations, the 2014 Integrated Field Exercise took place from 3 November to 9 December 2014 in Jordan. The exercise represented the largest field activity of the Commission since its inception. More than 360 experts and dignitaries from 53 States Signatories and the Secretariat participated in the event in various roles and functions. The Commission transported about 150 tonnes of equipment to Jordan, including equipment worth $10 million that had been provided as contributions in kind by nine States Signatories – Canada, China, the Czech Republic, Hungary, Italy, Japan, Sweden, the United Kingdom, the United States of America – and the European Union, and medical equipment and medicine provided by France.

Exercise activities were led and coordinated by a joint exercise management team comprised of both Secretariat staff and representatives from various governmental institutions and agencies of the host State. Exercise players were divided into three groups: the inspection team, the inspected State Party and, in Austria, the Operations Support Centre. Members of the control team and the evaluation team were not players in the exercise; the former controlled the exercise play and the latter provided an independent evaluation of the IFE.

The 2014 IFE had an opening ceremony with a series of high level visitors on 15 and 16 November, which involved 41 representatives from 28 States Signatories and the EU, representatives of 3 other international organizations and 7 non-governmental organizations, 14 representatives of the host State, and 3 members of the Group of Eminent Persons. Additionally, more than 30 observers were provided the opportunity to follow various parts of the exercise. To enable representatives from Permanent Missions based in Vienna to follow the exercise, the Commission arranged briefings on 13 November and 3 December at the OSC.

The five-week long exercise tested crucial aspects of each phase of an on-site inspection, both in Jordan and at the OSC.

OSI launch activities commenced in Vienna on 3 November with the receipt of the on-site inspection request by the Director-General. This, in turn, triggered the activation of the OSC and the assembly of the inspection team in Vienna on 4–6 November. Inspection team and OSC staff together prepared key planning documents such as the initial inspection plan, the logistics and operations support plan, and the inspection mandate.

With the arrival of the inspection team at Amman International Airport in the evening of 7 November, pre-inspection activities started immediately, with discussions on the handover of the inspection mandate. The next day, pre-inspection activities focused on three parallel activities: the negotiation of the initial inspection plan between the inspection team leadership and

representatives of the inspected State Party; the conduct of the inspection equipment check at a warehouse near the airport; and the deployment of an advance party of the inspection team to carry out a reconnaissance mission of the proposed base of operations near the Dead Sea.

On 9 November exercise participants were transported from the point of entry facility near the airport to the main exercise location at the Dead Sea. In addition, equipment that had been shipped as air cargo from Austria to Jordan was brought by several trucks to the inspection team's base of operations, which had been established at the Jordan Rally site near the Dead Sea.

Having established operational readiness and set up the base camp, inspection activities commenced in the afternoon of 10 November. Over the course of the inspection, the inspection team searched in an integrated manner an inspection area of nearly 1000 square kilometres using 15 of the 17 techniques permissible under the Treaty. These included position finding; ground based and airborne visual observation and photography; multispectral imaging, including infrared measurements; ground based and airborne monitoring of gamma radiation; environmental sampling, including noble gas sampling, above, at and below the surface, along with analysis; passive seismic monitoring; active seismic surveys; and various geophysical inspection techniques (ground based magnetic and gravitational field mapping, ground penetrating radar, electrical conductivity and resistivity measurements using time domain, frequency domain, and direct current instruments). In total, 210 field missions including sampling and laboratory activities at the base of operations were carried out during the 11 day initial period of the simulated inspection and the 14 day continuation period. As part of the investigation, inspectors created and assessed a total of 31 polygons within the inspection area and analysed 413 gigabytes of data gathered from inspection activities in the field.

The IFE was based on a scenario that had been carefully crafted by a group of experts from States Signatories and then peer reviewed by independent specialists in September 2013. In order to ensure a scientifically

credible, coherent and technically stimulating scenario, control team members prepared for and implemented various technical injects (e.g. aftershocks, satellite imagery and radionuclide measurement) to allow the exercise play to proceed in accordance with the control team timetable. Scenario preparations thus included extensive site modifications made at two locations in the inspection area.

In addition, for the noble gas related scenario simulations, mixtures of radioisotopes of xenon and argon or blanks were injected into noble gas detection equipment in accordance with the location of the samples taken by the inspection team in the field. Similarly, environmental sampling for radioactivity was simulated based on sample location by placing sealed ^{110m}Ag sources or blanks with each sample that the inspection team counted in combination with the use of specifically prepared conversion tables for radioisotopes detected by the team.

Top left: The Executive Secretary, Lassina Zerbo (centre), and the Director of the OSI Division, Oleg Rozhkov (left), meet with HRH Prince Feisal Bin Al Hussein of Jordan (right) and the General Secretary of the Jordanian Ministry of Foreign Affairs, Muhammad Tayseer Bani Yaseen, 15 November
Middle left: The Executive Secretary meets with Jordanian officials at the launch of the IFE, 16 November
Top right: The inspection team (in blue shirts) prepare to check the OSI equipment after arrival in Jordan, 8 November
Bottom row: IFE participants arrive at the point of entry, Amman International Airport, 7 November; representatives of the inspected State Party (in red shirts) meet, 7 November; the inspection team at their morning briefing, 8 November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Participants in the 2014 IFE

Surface contamination and hot spots near the prepared ground zero were also simulated by burying 10 ^{60}Co radiation sources underground. Seismic aftershocks were simulated by three explosions. Use of a weight drop source was planned but not executed as was the use of ^{137}Cs sources during the overflight. In addition, as an inject for one of the magnetic and deep electrical geophysical techniques, synthetic data sets were prepared. The inspection team successfully narrowed down the 1000 km^2 inspection area to the two prepared sites and it gathered and documented relevant facts in accordance with the prepared scenario.

With the conclusion of inspection activities on 5 December, post-inspection activities were exercised. They included, most notably, the preparation of a comprehensive preliminary findings document by the inspection team and the staged disassembly of the base of operations, involving the inventory, packing and preparation of the equipment and disposal of data and samples, for its return shipment to Austria.

The 2014 IFE activities concluded formally with the conduct of a debriefing held simultaneously in Jordan and at the OSC to take stock of first impressions and feedback from exercise participants. As part of the formal conclusion of the IFE, a press conference in Jordan on 7 December acted as the closing ceremony.

A preliminary review of the 2014 IFE clearly indicates that major improvements have been achieved in OSI operational readiness of the Commission since the conduct of the first IFE, in 2008 in Kazakhstan. These relate to progress in the further development and integrated application of various inspection techniques, the underlying operational and logistic concept, and the development of respective procedures. The successful conduct of the 2014 IFE also underlined the validity of the IFE planning and preparatory concept, with the three preceding build-up exercises forming an integral part of it.

A comprehensive public and media outreach strategy for the IFE was carried out in close cooperation with the host State. Output included dedicated areas of the Commission's web site and printed publications in Arabic and English, written and video blogs, TV broadcast packages, and press conferences in Austria and Jordan. It also involved field visits and social media activities, which benefited from interaction with exercise participants. These efforts resulted in the most thorough media coverage to date for any OSI activity, with TV reports by a number of media outlets including Al Jazeera in English and Arabic, BBC Arabic, Reuters TV, Associated Press Television News and China Central Television, as well as written reports by *Al-Ahram*, Petra news agency, *The Independent* and others, particularly in the Middle East.

Page 40, clockwise from top right: An airborne MSIR system being checked during an inspection overflight; harvesting SAMS data in the field; weight drop as an signal for seismic activity; the core inspection team prepare the initial inspection plan at the OSC during the launch phase; the base of operations; decontamination activity; logistics at the base of operations; delivery of the Intermodal Rapid Deployment System

Page 41, clockwise from top right: Loading OSI equipment; signing ceremony for the preliminary findings document at the end of the IFE; handover of the preliminary findings document; the base of operations at sunset; resistivity measurement in the field; SAMS station deployment in the field; the helicopter used by the inspection team for overflights of the inspection area; the entrance to polygon 18

The evaluation team for the 2014 Integrated Field Exercise meet in Jordan

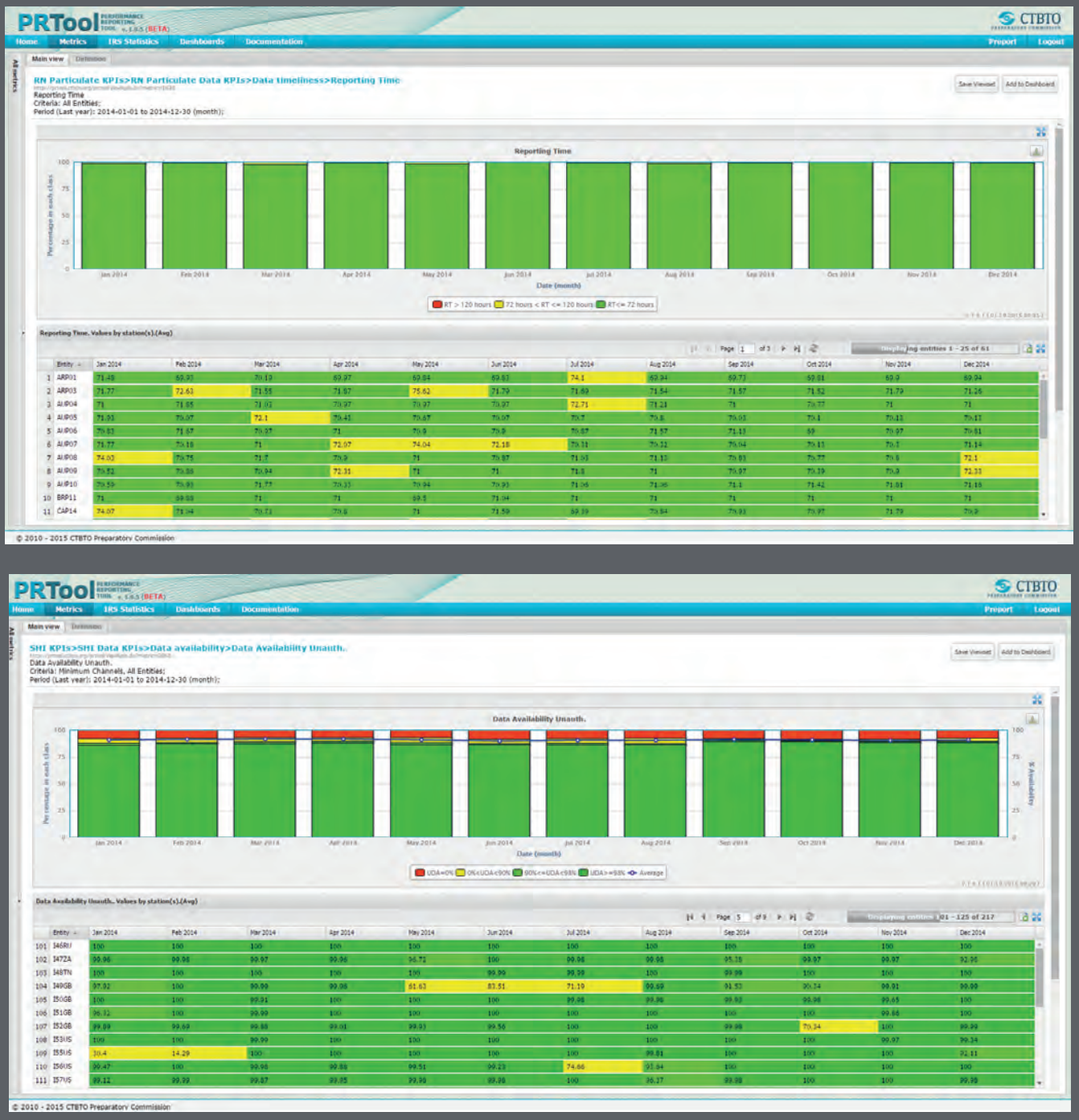
Highlights in 2014

Further development and consolidation of the Quality Management System

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

Evaluation of the 2014 Integrated Field Exercise

At all stages of the process of establishing the Treaty verification system, the Commission aims for effectiveness, efficiency and continual improvement through the implementation of its Quality Management System. The QMS focuses on recipients, such as States Signatories and National Data Centres, and aims to fulfil the responsibilities of the Commission to establish the verification regime in compliance with the requirements set forth in the Treaty, its Protocol and relevant Commission documents.



The PRTool, showing performance indicators for radionuclide and waveform data

The Quality Management System

To assure continuous provision of high quality products and services, the Commission pursued further improvement of the QMS in 2014. The QMS is a living system that can be adjusted, in keeping with the emphasis placed by the Commission on recipient needs and continual improvement.

During 2014 the Commission continued to consolidate the procedure for controlling and coding QMS documents (the QMS document management system). The Secretariat started to use the latest implementation of the document management system in a way that suited its specific needs.

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

The Performance Reporting Tool

The Commission continued to work towards bringing the Secretariat performance reporting tool (PRTool) fully into operation. A new version of PRTool was developed and released.

The Commission made more progress in validating the key performance indicators (KPIs) reported by PRTool, including the preparation of a validation plan. The plan comprises a validation framework, a proposed time line, a validation check list and additional information to support the validation process.

The new functionality of PRTool includes the set of KPIs for the new IMS waveform data performance metrics: data availability and data timeliness for the different subsets of station channels.

The definitions for radionuclide particulate and noble gas data availability have been updated to be consistent with the new definitions in the Operational Manuals. The upgraded display of these KPIs provides comprehensive information on the type and the status of the received spectra. PRTool users can identify whether the station was performing measurements for quality supporting spectra or for monitoring spectra. In the case of quality supporting spectra, a symbol is used to differentiate the type of spectrum (i.e. blank spectrum, detector background, calibration and spike). In addition, noble gas product timeliness has been implemented in the new version of PRTool.

Evaluating On-Site Inspection Activities

The focus for evaluation during 2014 was on site inspection activities, mainly the preparations for and the conduct of the evaluation of the 2014 Integrated Field Exercise.

The concept for the comprehensive evaluation of the IFE, as well as its three preceding build-up exercises over the whole period 2012–2014, was clearly set out in a rolling draft blueprint and a series of exercise specific evaluation frameworks. During 2012 and 2013 these documents provided for a 'formative' evaluation of all three BUEs in order to help shape the operational capability being exercised. In 2014 the final framework provided for a

Top: Training of the IFE evaluation team
Middle: The IFE evaluation team office in Jordan
Bottom: The IFE evaluation team at the base of operations

'summative' and hands-off approach to evaluation in order to sum up the demonstrated capability.

Throughout the year the Commission worked to update the evaluation methodology to reflect the required change of approach and to assimilate and apply the lessons learned from evaluating the BUEs. Applying the principal lessons involved two steps. First, the Commission provided a more comprehensive definition and breakdown of the operational capability that was to be evaluated. Second, it attempted to devise a better means to manage and process the mass of information gathered about each target in order to make the actual assessment more efficient, while providing for a historical record to be preserved.

In total, 18 evaluation targets were identified and defined using indicators and sub-indicators to situate aspects of the target in time and space across all phases of the IFE. This breakdown helped the evaluators to identify which aspects of each target they should assess and when they should expect to do so.

The development of a bespoke evaluation information management system successfully automated much of the evaluation workload and replaced the traditional paper based tools. In the first instance, the system used the new definition and structures to direct the acquisition of relevant information by the evaluators and the drafting of their initial findings. The system then allowed the evaluators to make their assessment by collating associated initial findings in order to create key findings. This subsequently helped them to collate associated key findings to create recommendations, thus providing for evidence based reporting.

An evaluation team workshop in May 2014 tested the prototype information management system and trained the evaluation team on its use. Feedback was immediately incorporated into the definitions. Feedback on the information management system was subsequently used to further develop it prior to beta testing in October and its release just prior to the IFE.

During the IFE, the external evaluation team of 10 evaluators located in Vienna and in Jordan undertook the summative evaluation of the exercise. A report on their principal findings, as well as the mass of technical details gathered by the team, will be made available to stakeholders in 2015.

Waveform analysts at the National Data Centre development workshop and training for Central Asia and the Caucasus

Highlights in 2014

Integration of National Data Centre capacity building with policy and educational outreach activities

Integration of all e-learning systems

Work on the 'extended NDC in a box' software

The Commission offers States Signatories training courses and workshops in technologies associated with the International Monitoring System, the International Data Centre and on-site inspection as well as on political, diplomatic and legal aspects of the Treaty. These courses help to strengthen national scientific and decision making capabilities in areas related to the Treaty. 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.

This capacity building enhances the technical capabilities of States Signatories around the globe and of the Commission by empowering all stakeholders to participate in implementing the Treaty on an equal footing and enabling them to enjoy the civil and scientific benefits of its verification regime. As technologies expand and improve, there is a need to update the knowledge and experience of national experts.

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.

Capacity Building Phases

The integrated capacity building programme for States Signatories includes outreach activities and education on all Treaty related matters. The programme provides training courses, workshops, exercises, software provision, equipment donations and technical follow-up visits.

The NDC capacity building programme has six phases:

- Development of country profiles for all States Signatories;
- Organization of regional NDC development workshops;
- Two week training courses for NDC technical staff;
- One month NDC analyst training courses;
- NDC visits by one or more technical experts;
- Provision of basic NDC computer equipment and software.

E-learning has considerably enhanced the programme. It is used on a routine basis and is a prerequisite for all training events for NDC technical staff, station operators and surrogate OSI inspectors. The e-learning modules are made available for authorized users, station operators, OSI inspectors and Secretariat staff. The Commission launched a new project in 2014 to integrate all e-learning activities across all Divisions under one user management system and on one platform. The migration of content to the new platform was completed in 2014.

Country Profiles

The Commission has developed a standard country profile for all States Signatories. This profile contains the information available to the Commission on the number of authorized users from a State, the State's use of IMS data and IDC products, and its participation in previous training events. The profiles serve as a reference before and during events and meetings with States.

NDC Workshops

The 2014 NDC workshop was held in Vienna in May. A key topic at the workshop was the review of the NDC Preparedness Exercise 2013. The results of that exercise were presented at the workshop, followed by in-depth discussion of the event based on all Treaty technologies and national data. The workshop also focused on the ability of NDCs to carry out their verification activities, including their approaches to accessing IMS data and IDC products. Another focus of the workshop was the cooperation among NDCs, including sharing of waveform and radionuclide data. The objectives of the workshop were to support NDCs in their work and to provide a forum for NDC experts to share experiences in fulfilling their verification responsibilities and provide feedback to the Commission on all aspects of its data, products and services.

An NDC development workshop combined with a training course for Central Asia and the Caucasus was conducted in 2014 in Almaty, Kazakhstan. The purpose was to strengthen the knowledge of the Treaty and the work of the Commission and to further build up the capacity of countries to participate in the implementation of the verification regime. It also provided a forum to assess how participants are making use of IMS data and IDC products, including for civil and scientific applications, and to promote the exchange of both experience and expertise among the NDCs. The workshop included presentations from the Commission that emphasized the information needed to build and sustain NDCs and from representatives of NDCs in different stages of development. It also provided opportunities for the Commission to collect additional information to update the country profiles. This workshop was combined with training on sharing data and cooperating on the regional seismic travel time model in the region.

The Commission organized the third East Asia regional NDC workshop in July and August in Ulaanbaatar, with over 30 participants from the region. The objective was to establish a forum for the exchange of information and expertise between the NDCs in East Asia. The East Asian NDCs conducted a joint exercise prior to the workshop and the results were presented and discussed at the meeting.

NDC Training Courses

The Commission offered two intensive, month long NDC waveform analyst training courses in 2014. The objectives of the courses were to further strengthen the capacity of States Signatories to participate in the verification regime and to enhance their use of data and products of the Commission for civil and scientific applications. This type of course enables participants to deepen their knowledge of Commission data and products and of waveform analysis through real life, hands-on training exercises as well as interaction with analysts working at the IDC.

The Commission organized three two week training courses on access to and analysis of IMS radionuclide data and IDC products. The course objectives were to understand the roles of NDCs in the verification regime, to build or improve NDC capabilities, to provide participants with sufficient knowledge to access and use IMS data and IDC products, and to provide practical experience in analysing IMS radionuclide data.

The Commission organized one NDC analyst training course in Bucharest for States in Latin America and the Caribbean, Eastern Europe, and South East Asia, the Pacific and the Far East under Decision V of the Council of the European Union. The objectives were to strengthen the capacity of States Signatories to participate in the verification regime, to build or improve NDC capabilities, to provide participants with sufficient knowledge to access and use IMS data and IDC products for Treaty monitoring and civil and scientific applications, and to provide practical experience in analysing IMS waveform data.

Two national seminars in combination with NDC hands-on training sessions were conducted in two States Signatories in Africa. These aimed to expand understanding of the Treaty and the functions of various components of the verification regime and to provide training to NDC staff on using the installed capacity building system equipment for Treaty verification and in the civil and scientific applications of the verification technologies.

NDC Support

As part of its capacity building strategy, the Commission bought sets of equipment that provide an adequate technical infrastructure for NDCs. These purchases were financed by the Regular Budget of the Commission and by EU Council Decision IV. The equipment was provided to three NDCs. In addition, the organization donated eight capacity building systems to States Signatories to establish or strengthen their NDCs, enhance their capacity to participate in the verification regime, and develop civil and scientific applications in accordance with national needs.

Software to process and analyse IMS data is made available to all authorized users. The Commission enhanced the tools for analysing seismic data (Geotool) and radionuclide data in 2014 and it improved the tool for post-processing of atmospheric transport results

Top: A field excursion during the East Asia regional NDC workshop
Middle: Hands-on training at the East Asia regional NDC workshop
Bottom: Participants in the 2014 NDC workshop visit the Conrad Observatory, outside Vienna

(WEB-GRAPE). The organization has started work on integrating various waveform data analysis tools, including SeisComP3 and Geotool, into a new software distribution called 'extended NDC in a box'. This project is funded by the EU. The alpha testers group has been constituted to represent the NDC in a box user community and help specify the needs of those who will use the final product. The Commission also wrote the baseline requirements document and began work on the first release of the new software in 2014. The software is expected to be released in the first quarter of 2015.

NDCs continued to receive technical support from the Commission upon request. This covered data access, special data handling, software issues and questions related to data analysis.

The Commission provided a diverse range of training events for station operators in 2014. Station managers and operators benefited from 13 courses. These were largely on the use and maintenance of equipment but also covered procedures related to reporting and communication with the Commission. The latter included one prototype training course for Public Key Infrastructure operators. The training events also involved a special programme for managers of IMS stations and NDCs in South East Asia, the Pacific and the Far East. The objectives were to train on the procedures for data transfer, the testing and evaluation process, and ways to ensure the sustainability of the IMS segment in China.

The e-learning system was expanded by 6 new modules (bringing the total to 48 modules). A further 2 modules were translated into the official United Nations languages (bringing the total to 20 modules).

Workshops on Monitoring Technologies

The Commission conducted two workshops on monitoring technology and one technical meeting in 2014.

A workshop on atmospheric transport modelling was held in September in Stockholm, Sweden. One of the primary tasks when analysing radionuclide data from the IMS for verification of the Treaty is to locate and characterize the

Top: Participants at the Annual Infrasound Workshop
Middle: Presentations at the Annual Infrasound Workshop
Bottom: Technical training for Russian-speaking station operators of waveform stations

sources of the measured radionuclides. NDCs must perform a timely, accurate and robust analysis on a routine basis of nuclide specific data from a global network of monitoring stations. The work includes identification of anomalies and source attribution when possible. There is a need for an in-depth scientific discussion on how data measurement and ATM techniques can be used in a combined analysis to optimize accuracy and robustness in the source locations obtained, and how to quantify precision and accuracy. The goal of the workshop was to review and identify the most effective ways forward in the main areas of measurements, ATM and combined analysis.

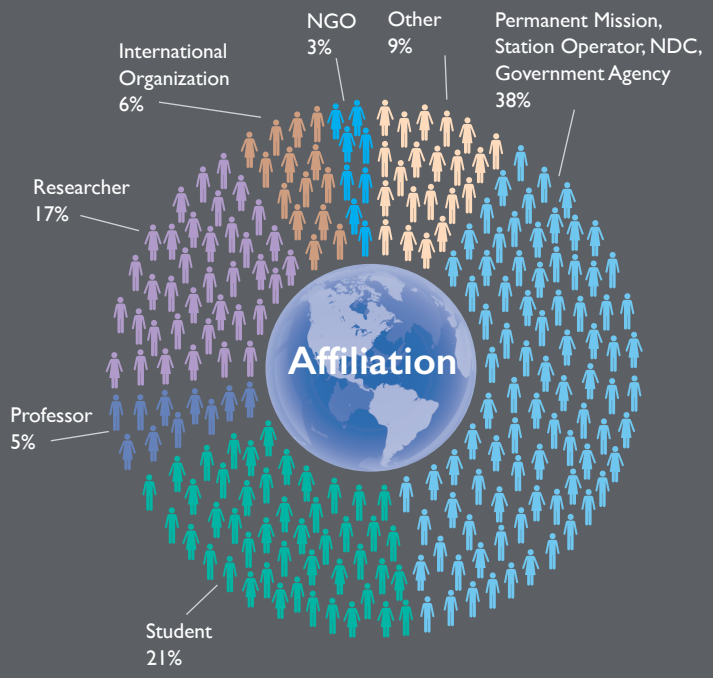
The Commission organized the annual infrasound technology workshop in Vienna in October. The objective of the workshop was to create an international forum for presenting and discussing recent advances in infrasound research and operational capabilities of global and regional networks. The topics covered during the workshop included infrasound instrumentation, modelling, data processing, station performance and network detection capabilities, as well as analysis of infrasound sources and civil and scientific applications of infrasound. A total of 78 participants from 30 States, together with 5 Secretariat staff, contributed high quality scientific and technical content. The workshop demonstrated the maturity of infrasound technology and explored technical advancements of interest to the Commission. Two side meetings focused on the IDC framework for detector evaluation and specifications, tests and calibration of IMS infrasound sensors.

The Commission organized a technical meeting on waveform technology software engineering at the IDC in June in Vienna. This meeting brought together scientists and software developers to review deliverables of the second phase of IDC reengineering, which had started at the beginning of 2014. The participants were briefed on the work done by the Commission and provided input on system requirements and their priority. A total of 19 participants from 12 States contributed to the event.

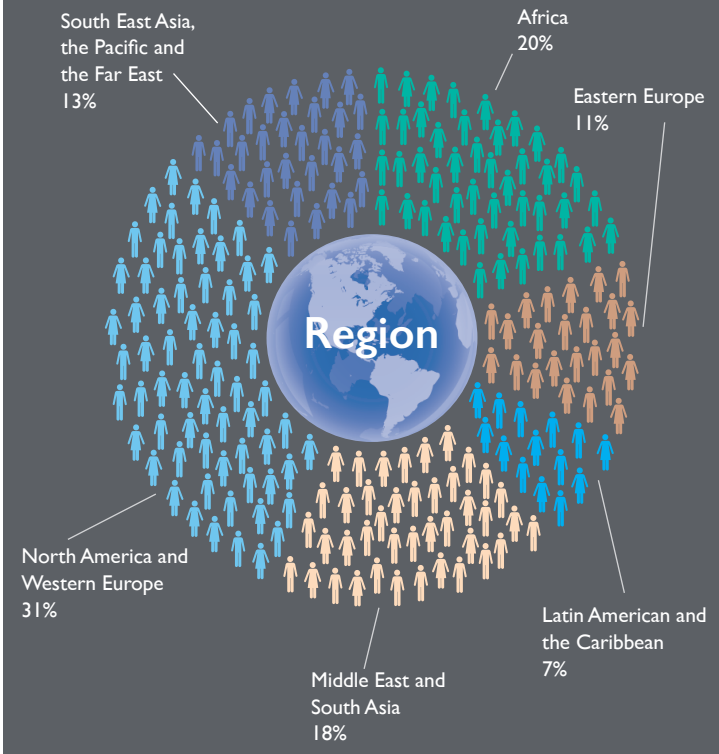
Regional Conferences and Information Visits

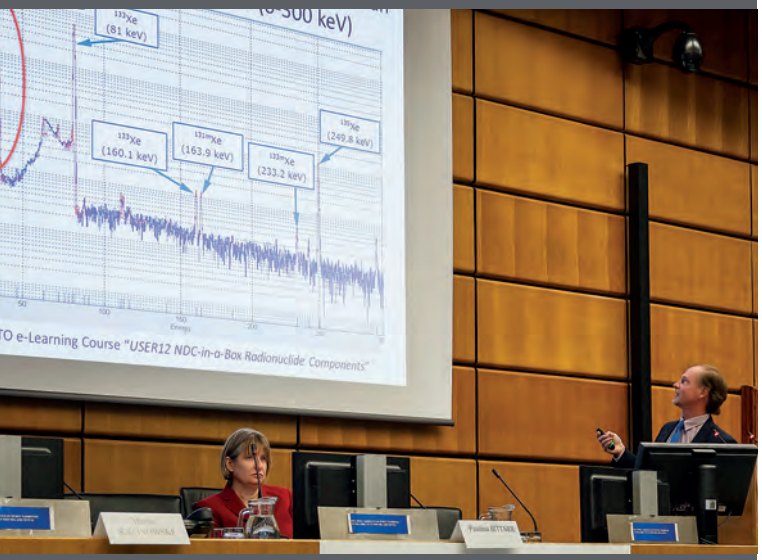
A regional conference for South East Asia, the Pacific and the Far East was held in Jakarta, Indonesia, in May. The conference, which was addressed by the Executive Secretary, was hosted by the Government of Indonesia with the support of the EU and Japan. It gave participants from throughout the region the opportunity to interact

Affiliation of Participants in Education and Outreach Activities, 2010–2014



Regional Distribution of Participants in Education and Outreach Activities, 2010–2014





Scenes from the CTBT Public Policy course

and to discuss technical, scientific, legal and political aspects of the Treaty, with a view to further increasing the number of signatures and ratifications from States in South East Asia, the Pacific and the Far East. The conference combined high level political engagement with enhanced awareness and understanding of the Treaty and its verification regime. It also highlighted the need for the establishment and operation of NDCs as well as the civil and scientific benefits of IMS data. The conference emphasized the importance of enhancing capacity building in the region through the integration of technical, policy making and educational aspects.

In combination with the CTBT Public Policy course (see below), the Commission hosted an information visit for government representatives from selected States that have not yet ratified the Treaty in September. The States invited included the Comoros, Cuba, Egypt, Iran, Myanmar, Nepal, Pakistan, Swaziland, Yemen and Zimbabwe. The objectives of this information visit were to familiarize participants with the significance of the Treaty, the legal and technical aspects of its verification regime, and the work of the Commission and to enable them to use the acquired knowledge to promote the Treaty and its ratification by their States. Holding the visit concurrently with the course not only reduced costs but also enabled participants to engage in more thorough discussions than was possible in the previous standard two day information visits, including greater opportunity for interaction with experts from all Divisions of the Secretariat.

Educational Outreach

As part of its integrated capacity building approach, the Commission continued to expand its education and outreach activities in 2014. These activities aim to broaden knowledge of the Treaty and to develop capacities in States Signatories to confront effectively the political, legal, technical and scientific challenges facing the Treaty and its verification regime.

The CTBT Academic Forum, supported by voluntary contributions from the EU, the Government of Norway and the Swedish Radiation Safety Authority (SSM), was held in May 2014. The forum brought together over 40 academics from a diverse range of universities and research institutes representing 20 States in Africa, Asia, Europe, Latin America and North America. The participants also included representatives from seven

Participants in the CTBT Public Policy course

of the eight Annex 2 States that have yet to ratify the Treaty. The main objectives of the forum were to further explore innovative methods for integrating Treaty related issues into academic curricula, as well as addressing research needs and opportunities. The forum also saw the launch of a research fellowship programme for scholars conducting advanced research on areas related to the Treaty and its verification regime, including the nexus between science and diplomacy.

The 2014 CTBT Public Policy course, on verification through diplomacy and science, took place in Vienna in September, with financial support from the EU, the Government of Norway and the SSM. It covered various aspects of the Treaty, such as policy and legal issues, including entry into force and universalization of the Treaty, and the verification technologies and their civil and scientific applications. The course itself comprised newly developed e-learning modules, tours and demonstrations on technical elements of the IMS and IDC operations. It involved presentations by Treaty experts and panel discussions focusing on practical understanding of political, legal, diplomatic and technical aspects of the Treaty with specific focus on OSI in order to raise awareness about the IFE. A one day OSI introductory course provided intensive lectures, interactive quizzes and tabletop exercise on point of entry procedures. It also offered a panel discussion through which participants consulted OSI experts on how to get involved, support and join OSI activities. Approximately 100 participants attended the course in Vienna, while over 500 registered to follow the course online via live stream and video archives. Course participants included diplomats, government officials, station operators, NDC staff members, representatives from other international organizations, academics and scientists, including from seven non-ratifying Annex 2 States.

During 2014, more than 550 participants registered for the educational and outreach courses of the Commission, and 158 certificates for successful completion were issued. In addition, the CTBT education portal was used by almost 8000 users from 170 States, including almost all of the non-ratifying Annex 2 States.

The Commission also promoted online education and training materials on the Treaty through its iTunes U site, which currently has 15 collections including 5 seminar courses with more than 415 freely shareable files. The site has over 1600 subscribers, with 13 000 visitors and 14 000 downloads of content in 2014.

The Group of Eminent Persons meeting in Stockholm, April 2014

Highlights in 2014

Further promotion of the Treaty and its universalization

Ratification of the Treaty by the Congo and Niue

Consolidation of outreach and education activities

The Commission pursues outreach activities to promote universalization of the Treaty and its entry into force. The activities aim to enhance understanding of the Treaty, the functions of the Commission, the Treaty verification regime, and the civil and scientific applications of the verification technologies. Outreach entails interaction with the international community, including States and international organizations as well as non-State actors, such as academic institutions and the media.

The interaction involves promoting the signature and ratification of the Treaty by States, promoting understanding of the objectives, principles and benefits of the Treaty by government representatives and the general public at large, and fostering international cooperation in the exchange of verification related technologies.

Towards Entry into Force and Universality of the Treaty

The Treaty cannot enter into force until it has been ratified by 44 States that are listed in Annex 2 of the Treaty. The Annex 2 States 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. As of 31 December 2014, 8 of these 44 States had not yet ratified the Treaty, including 3 that had not yet signed it.

Political support for the Treaty and the work of the Commission continued to be strong in 2014. The Treaty is considered to be an effective instrument of collective security and an important pillar of the nuclear anon-proliferation and disarmament regime. An increasing number of States, decision makers and representatives of civil society spearheaded the campaign in 2014 for further ratification of the Treaty, including by the remaining Annex 2 States. States and regional organizations also continued to support the work of the Commission through voluntary contributions. These efforts indicate the international recognition of the critical role of the Treaty in today's security environment.

The Treaty continued to gather momentum towards entry into force and universalization, with ratifications by the Congo and Niue. As of 31 December 2014, the Treaty had been signed by 183 States and ratified by 163 States, including 36 of the 44 Annex 2 States. The Commission conducted consultations with almost all States that had not yet ratified or signed the Treaty. Moreover, in order to promote additional signatures and ratifications, it liaised with a large number of ratifying States, the United Nations and other global and regional organizations, as well as institutions such as the Inter-Parliamentary Union (IPU) – all of which work closely with the Commission in its effort to move towards entry into force and universality of the Treaty.

A meeting of the Group of Eminent Persons (GEM) was held in Stockholm in April 2014. It brought together a number of senior statesmen, active and former politicians, and internationally recognized experts to promote the entry into force of the Treaty and reinvigorate international endeavours to achieve this goal. During

Top: Carl Bildt, Foreign Minister of Sweden, and Lassina Zerbo, Executive Secretary, at the GEM meeting, Stockholm
Upper middle: Hans Blix, GEM member and former Director General of the IAEA
Lower middle: William Perry, GEM member and former US Secretary of Defense
Bottom: Participants in the GEM meeting in Stockholm

the opening session, the Executive Secretary outlined a strategy and action plan to secure ratification by the outstanding Annex 2 States. The Swedish Foreign Minister, Carl Bildt, also joined GEM members in a brainstorming session that focused on the role of the group in advancing entry into force by raising the profile of the Treaty and the work of the Commission. The meeting concluded with a panel discussion involving the Executive Secretary, Kevin Rudd, a former Australian Prime Minister, and Hans Blix, a former Director General of the International Atomic Energy Agency. The panel discussion was organized by the Swedish Ministry for Foreign Affairs in cooperation with Stockholm International Peace Research Institute (SIPRI) and the Swedish Institute of International Affairs (UI).

The regional conference for South East Asia, the Pacific and the Far East in Jakarta in May served to encourage further signatures and ratifications from the region (see above). Representatives from non-ratifying States such as China, Myanmar, Papua New Guinea, Solomon Islands and Tonga benefited from the conference and the interaction with the Executive Secretary, Secretariat staff and representatives from ratifying States in the region.

The 2014 CTBT Public Policy course, on verification through diplomacy and science (see above), increased understanding of the importance of the Treaty and its verification regime and familiarized participants with the work of the Commission, thus enabling them to leverage the acquired knowledge in promoting the Treaty in their countries and building support for it. With the special focus on the eight non-ratifying Annex 2 States, representatives from seven of these States attended the course.

Interacting with States

In 2014 the Commission continued efforts to facilitate implementation of its decisions on establishing the verification regime and promoting 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 hosting facilities of the International Monitoring System and States that have not yet signed or ratified the Treaty, in particular those listed in Annex 2.

The Commission took advantage of various 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 IMS. Commission representatives attended meetings of the African Union, the IAEA, the IPU, the Organization for Security and Co-operation in Europe (OSCE), the United Nations General Assembly and the United Nations Office for Disaster Risk Reduction.

The Executive Secretary continued to engage proactively with States to further promote the Treaty, its entry into force and universalization, and the use of the verification technologies and data products. He undertook to strengthen the engagement of these States with the Commission and to emphasize the significance of entry into force of the Treaty. He participated in several bilateral meetings and other high level events. He visited Ethiopia in January, the United Kingdom of Great Britain and Northern Ireland in February, Israel in March, Sweden, Argentina and Ecuador in April, Indonesia and Germany in May, the Republic of Korea in August, Slovakia, Jordan, the United Arab Emirates and the Russian Federation in November, and the Czech Republic in December. In addition he visited the United States of America in April–May, September, October and November.

During his visits and at meetings held in Vienna, the Executive Secretary met several heads of State and Government, foreign ministers and other senior government representatives. The heads of State and Government included Mr Serzh Sargsyan, President of Armenia; Ms Catherine Samba-Panza, President of the Central African Republic; Mr Idriss Déby, President of Chad; Ms Michelle Bachelet, President of Chile; Mr Denis Sassou N'Guesso, President of the Congo; Mr Ali Bongo Ondimba, President of Gabon; Mr Alpha Condé, President of Guinea; Mr Shimon Peres, President of Israel; Mr Abdullah Ensour, Prime Minister of Jordan, and Prince Feisal Al-Hussein of Jordan; Mr Mohamed Ould Abdel Aziz, President of Mauritania; Mr Tsakhiagiin Elbegdorj, President of Mongolia; and Mr Salva Kiir Mayardit, President of South Sudan. The foreign ministers included Mr Georges Rebelo Chicoti, Minister of Foreign Affairs of Angola; Mr Héctor Timerman, Minister of Foreign Affairs of Argentina; Mr Sebastian Kurz, Minister for Foreign Affairs of Austria; Mr Laurent Fabius, Minister of Foreign Affairs of France; Mr Frank-Walter Steinmeier, Minister for Foreign Affairs of Germany; Mr Marty Natalegawa, Minister of Foreign Affairs of Indonesia; Mr Mohammad Javad Zarif, Minister of Foreign Affairs of the Islamic Republic of Iran; Mr Avigdor Lieberman, Minister of Foreign Affairs of Israel and Mr Yuval Steinitz, Minister of Strategic Affairs, Intelligence and International Relations of Israel; Ms Federica Mogherini, Minister for Foreign Affairs of Italy (and designated High

Representative of the European Union for Foreign Affairs and Security Policy); Mr Fumio Kishida, Minister for Foreign Affairs of Japan and Mr Nobuo Kishi, Vice Minister for Foreign Affairs of Japan; Mr Nasser Judeh, Minister for Foreign Affairs and Expatriates of Jordan; Mr Yun Byung-se, Minister of Foreign Affairs of the Republic of Korea; Mr Sergey Lavrov, Minister of Foreign Affairs of the Russian Federation; Mr Miroslav Lajčák, Deputy Prime Minister and Minister of Foreign and European Affairs of Slovakia; Mr Abdullah bin Zayed Al Nahyan, Minister of Foreign Affairs of the United Arab Emirates; Mr Hugh Robertson, Minister of State for Foreign and Commonwealth Affairs of the United Kingdom; and Mr John Kerry, Secretary of State of the United States of America. He also met Mr Shaul Chorev, Head of the Israel Atomic Energy Commission; Mr Khaled Toukan, Chairman of the Jordan Atomic Energy Commission; and Ms Marta Žiaková, Chairperson of the Nuclear Regulatory Authority of Slovakia.

Outreach Through the United Nations System, Regional Organizations, Other Conferences and Seminars

In February the Executive Secretary addressed the Forum for Security Co operation of the OSCE.

In April-May the Executive Secretary attended the third session of the Preparatory Committee for the 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons in New York. He addressed the committee on the role of the Treaty and the work of the Commission as an essential element of the nuclear non-proliferation and disarmament regime and underlined the urgency of entry into force.

Representatives of the Commission also participated in the third preparatory meeting to the third Conference of States Parties and Signatories of Treaties that Establish Nuclear-Weapon-Free-Zones in May in New York.

The Director of the Legal and External Relations Division represented the Executive Secretary at the third Conference of the States Parties to the African Nuclear-Weapon-Free Zone Treaty in Addis Ababa in May.

Top: The Executive Secretary, Lassina Zerbo, meets the Foreign Minister of Indonesia, Marty Natalegawa
Upper middle: President Serzh Sargsyan of the Republic of Armenia meets with CTBTO Executive Secretary Lassina Zerbo
Lower middle: The President of Mongolia, HE Tsakhiagiin Elbegdorj, visits the Vienna International Centre, 15 October 2014
Bottom: The artist Doug Waterfield (centre left) presents his 'Doomtown' series of paintings to the Executive Secretary, Lassina Zerbo (centre right), Ambassador Kairat Sarybay of Kazakhstan (left) and Ambassador Selwyn Das of Malaysia, Chairperson of the Preparatory Commission (right), on the International Day against Nuclear Tests, 29 August 2014

In September the Executive Secretary was represented at the General Conference of the IAEA in Vienna by the Director of the OSI Division, who delivered a statement on his behalf.

Throughout the year, the Commission representatives also participated in a number of relevant United Nations meetings, in particular at the First Committee of the General Assembly and at the General Assembly's plenary consideration of the annual resolution on the Treaty. After the delivery of the annual report of the Commission to the United Nations General Assembly, the General Assembly adopted a resolution, without a vote, on cooperation between the United Nations and the Commission (A/RES/69/112).

The Executive Secretary also attended the following conferences and meetings: a workshop on the Non-Proliferation Treaty in Annecy, France, in March; a conference marking Africa Day held in Berlin in May; the Arms Control Association conference on nuclear weapon testing in Washington, DC, in September; the Hoover Institution conference on advancing nuclear security at Stanford University, United States of America, in September; the World Economic Forum Summit on the Global Agenda in Dubai in November; the Moscow Non-Proliferation Conference, on nuclear energy, disarmament and non-proliferation, organized by the Center for Energy and Security Studies in November; the Prague Agenda Conference, organized by the Ministry of Foreign Affairs of the Czech Republic, the Charles University Faculty of Social Sciences and the Metropolitan University Prague, in December; and the Vienna Conference on the Humanitarian Impact of Nuclear Weapons in December.

From 8 to 11 September the Commission hosted a group of 25 United Nations disarmament fellows. Among them there were 4 participants from non-ratifying States. This group was addressed by the Executive Secretary and received an overview of the Treaty and its verification system and tours of the operations centre of the International Data Centre. The programme for the fellows' visit was arranged in tandem with the CTBT Public Policy course and concluded with a simulation exercise of a future CTBTO Executive Council deliberation on an OSI request.

The 2014 Integrated Field Exercise

With observers from 31 States Signatories, international organizations, research organizations and GEM, the 2014 IFE provided an opportunity to promote the Treaty and to demonstrate the capabilities of its verification regime. The high level event for dignitaries brought ministers and senior officials from a number of countries together to observe progress in the most comprehensive OSI simulation yet carried out.

Public Information

During 2014 the public web site and social media outlets of the Commission received an average of around 193 000 visits per month, 29% more than in 2013. The web site was updated with 59 'highlight' articles and 8 press releases and media advisories. The Commission issued 12 electronic newsletters and continued to expand its presence on YouTube, Facebook, Twitter and Flickr.

Forty videos were added to the Commission's YouTube channel, which attracted around 115 000 views, equivalent to 277 days of videos being watched. Television stations around the world broadcast a story on the reconstruction of the IMS hydroacoustic station HA3, which was jointly produced by the Commission and United Nations TV in all United Nations languages. United Nations radio also distributed stories and interviews on the Commission in all United Nations languages.

Issue 22 of *CTBTO Spectrum* was published to coincide with the International Day against Nuclear Tests on 29 August. It included contributions from the Prime Minister of Jordan, Abdullah Ensour, and Ryan Wilcox, a former Republican member of the Utah House of Representatives, as well as articles by leading scientists and non-proliferation experts. Over 4000 copies were distributed worldwide to States Signatories, non-governmental organizations, research institutions, universities and the media.

Over 53 000 visitors to the Vienna International Centre toured the permanent exhibition on the Commission, with over 1000 visitors receiving individual presentations. The permanent displays on the Commission at the United Nations in New York and Geneva attracted even more visitors. A temporary art exhibition was installed in Vienna for the International Day against Nuclear Tests.

The Commission started work on promotion and outreach for the CTBT: Science and Technology 2015 conference. This included targeted outreach work at major scientific conferences, creation of a dedicated area of the Commission web site, and the design and production of

a range of promotional materials, including a brochure, a poster and a postcard for distribution to scientific and research institutes.

Global Media Coverage

Global media coverage of the Treaty and its verification regime remained high, with around 700 articles and citations in online media alone, including a report by CNN on the Commission's hydroacoustic network in connection with the search for the missing Malaysian Airlines flight MH370. The IFE led to a notable increase in media reporting, especially in the Middle East.

National Implementation Measures

In 2014 the Commission continued to promote the exchange of information between States Signatories on national implementation measures. A panel discussion on implementing Treaty obligations and the role of the national authority was held in the framework of the CTBT Public Policy course. The objectives of the panel discussion were to increase awareness of the important role that national authorities have in Treaty implementation and to identify measures to ensure that national authorities can be most effective. Panellists included experts from Argentina, Japan, Kenya and the Organisation for the Prohibition of Chemical Weapons (OPCW).

Top: Al Jazeera reports on the Integrated Field Exercise
Upper and lower middle: Media attention during the IFE
Bottom: Activities marking the International Day Against Nuclear Testing

The seventh Ministerial Meeting on Promoting the Entry into Force of the Treaty, New York, 26 September 2014

Highlights in 2014

High level political support for the Treaty

The importance of the 2014 Integrated Field Exercise in advancing on-site inspection capabilities

Acknowledgement of the role of the Group of Eminent Persons

Every two years, the States that have ratified the Treaty meet in a Conference on Facilitating the Entry into Force of the CTBT (also known as an Article XIV conference). In the years between the 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 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.

New York, 2014

The seventh Ministerial Meeting was held on 26 September 2014, jointly hosted by the foreign ministers of Australia, Canada, Finland, Japan, Mexico, the Netherlands and Sweden. It highlighted the importance of the Treaty and the political determination of the international community to advance its entry into force and universality.

Foreign ministers and senior officials from around 90 countries attended the meeting and participated in its deliberations. The foreign ministers' joint statement noted that the entry into force of the Treaty would rid the world of nuclear explosions and would contribute to the elimination of nuclear weapons by constraining their development and qualitative improvement. The statement also acknowledged the role of the Group of Eminent Persons in assisting in the entry into force process and highlighted the importance of the 2014 Integrated Field Exercise for advancing the on site inspection operational capabilities of the Commission.

The United Nations Secretary-General, Ban Ki-moon, echoed the sentiments of the meeting by calling on the eight remaining Annex 2 States to ratify the Treaty without further delay. He also underscored his strong personal commitment to the Treaty by noting that he had missed none of the Ministerial Meetings during his term as Secretary-General.

The overwhelming support for the Treaty was further demonstrated in December by the adoption by the United Nations General Assembly of a resolution on the Treaty, with 179 States voting in favour and only 1 voting against. 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 establishment of GEM to complement efforts to secure ratifications from the remaining Annex 2 States.

Top: Ban Ki-moon, United Nations Secretary-General
Upper middle: John Kerry, United States Secretary of State
Lower middle: Federica Mogherini, designated High Representative of the European Union for Foreign Affairs and Security Policy
Bottom: Representatives of States Signatories at the seventh Ministerial Meeting

Scenes from the Forty-Second Session of the Preparatory Commission, June 2014

Highlights in 2014

Participation of the United Nations High Representative for Disarmament Affairs in the Forty-Second Session of the Commission

Appointment of a new Chairperson of Working Group B

Seeking new approaches to the funding of the activities of the Commission

The plenary body of the Commission, which is composed of all States Signatories, provides political guidance and oversight to the Secretariat. 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 (AG) of qualified experts serves in a supporting role, advising the Commission through its Working Groups on financial, budgetary and associated administrative matters.

Meetings in 2014

The Commission and its subsidiary bodies each met in two regular sessions in 201. There were also joint meetings of WGA and WGB on 24 February and 25 August and a Special Session of the Commission took place in August.

Among the major issues address by the Commission during 2014 were promotion of the Treaty; procedures for appointment of the Chairpersons and Vice-Chairpersons of its subsidiary bodies; introducing biennial budgeting; multiyear funding; preparation for the 2014 Integrated Field Exercise; progress in completion of the International Monitoring System; and changes to Staff Regulations and Rules to introduce short term appointments. The United Nations High Representative for Disarmament Affairs, Angela Kane, participated in the Forty-Second Session of the Commission, in June.

The Commission also appointed Mr Joachim Schulze as the new Chairperson of Working Group B starting from 17 March 2015.

Supporting the Commission and Its Subsidiary Bodies

The Secretariat is the body that executes the decisions adopted by the Commission. It is multinational in composition: its staff is recruited from States Signatories on as wide a geographical basis as possible. The Secretariat 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 Secretariat is a vital element in the work of the Commission and its subsidiary bodies.

Virtual Working Environment

Through the Experts Communication System (ECS), the Commission provides a virtual working environment for those 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

Meetings of the Commission during 2014

Meetings of the Commission and its Subsidiary Bodies in 2014

Body	Session	Dates	Chairperson
Preparatory Commission	Forty-Second	16–17 June 21 August (Special Session)	Ambassador Toshiro Ozawa (Japan)
	Forty-Third	28–30 October	Ambassador Selwyn Das (Malaysia)
Working Group A	Forty-Fifth	26 May	Ambassador Aliyar Lebbe Abdul Azeez (Sri Lanka)
	Forty-Sixth	6 October	Ambassador Aliyar Lebbe Abdul Azeez (Sri Lanka)
Working Group B	Forty-Second	17–28 February	Mr Hein Haak (Netherlands)
	Forty-Third	18–29 August	Mr Hein Haak (Netherlands)
Advisory Group	Forty-Second	2–8 May	Mr Michael Weston (United Kingdom)
	Forty-Third	1–3 September	Mr Michael Weston (United Kingdom)

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 (SSO) infrastructure of the Commission. With the adoption of a new, more interactive and collaborative, method of work by WGB, the ECS has become even more important as a tool for continuous and inclusive discussion among States Signatories and experts on complex scientific and technical issues related to the verification regime.

As part of the virtual paper approach, through which the Commission is seeking to limit its output of printed documentation, the Secretariat provided a 'print on demand' service at all sessions of the Commission and its subsidiary bodies. In place of supplying printed copies of all documents to each participant, this service enabled delegates to print copies of those documents that they required directly from their computers and mobile devices during the meetings. The Secretariat continued to distribute on CD all documents of and presentations to the Commission and its subsidiary bodies at their sessions.

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 (ISTHAR) 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 ISTHAR interface has now been integrated into the SSO infrastructure and it continued to be available to all users of the ECS.

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 October 2012 the Commission extended the project for a further three years (2013–2015), subject to availability of sufficient voluntary contributions. A detailed annual report on the status of implementation of the project was issued in October.

Ten experts were supported under the project in the first half of 2014. They came from Brazil, Burkina Faso, the Dominican Republic, Jordan, Kenya, Kyrgyzstan, Madagascar, Niger, Paraguay and Vanuatu. In the second half of 2014, two new experts, from Ecuador and Yemen, replaced the outgoing experts from Brazil and Kenya. The experts took part in the Forty-Second and Forty-Third Sessions of WGB, including formal meetings, meetings of the expert groups and meetings of their respective geographical groups. In addition, the experts benefited from technical discussions with the Secretariat and the WGB Chairperson on key verification related issues.

The project has supported a total of 26 participants, including 6 females, since its inception in 2007. The participants came from 8 States in Africa (Algeria,

Burkina Faso, Ethiopia, Kenya, Madagascar, Niger, South Africa, Tunisia), 7 in Latin America and the Caribbean (Bolivia, Brazil, Dominican Republic, Ecuador, Mexico, Paraguay, Peru), 4 in the Middle East and South Asia (Kyrgyzstan, Jordan, Sri Lanka, Yemen), and 7 in South East Asia, the Pacific and the Far East (Indonesia, Mongolia, Papua New Guinea, the Philippines, Samoa, Thailand, Vanuatu). Seven of these are least developed countries.

In 2014 the project was financed by the most recent voluntary contributions, received from China, Norway, the Netherlands, Sri Lanka, Turkey and the European Union. The Commission continues to seek additional voluntary contributions to ensure the financial sustainability of the project.

The Vienna International Centre, seat of the Commission

Highlights in 2014

Initiation of the Voluntary Support Forum

Further increase in the number of female staff in the Professional category

Completion of the Enterprise Resource Planning project

Effective and efficient management of the activities of the Secretariat, including support of the Commission and its subsidiary bodies, is ensured mainly through the provision of administrative, financial and legal services.

A wide variety of general services are also provided, 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 Vienna International Centre over planning of office and storage space, maintenance of the premises and common services, and enhancement of security efforts.

Throughout 2014 the organization continued to focus on smart planning to streamline its activities and to increase synergies and efficiencies. It also accorded priority to 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 organization.

In order to ensure its independence and objectivity, Internal Audit reports directly to the Executive Secretary and has direct access to the Chairpersons of the Advisory Group and Working Group A. The Chief of Internal Audit also independently submits an annual activity report for consideration by the Commission and its subsidiary bodies.

In 2014 five audits were completed and recommendations were formulated to improve internal controls and organizational efficiency and effectiveness.

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

Midterm Strategy for 2014–2017

The Midterm Strategy (MTS) for 2014–2017 was presented in 2013 to guide the activities of the Commission for a period of four years by defining its strategic priorities. The MTS sets two strategic goals: (1) operation and sustainment of the verification system and (2) development of on-site inspection operational capabilities.

In support of these goals, two key strategic enablers were identified: integrated capacity building and improved management and coordination. Strategic enablers are the tools and activities that are to be directly applied to achieve the strategic goals and the overarching mission of the organization.

The CTBTO Organizational Management Programme Achievement Status System (COMPASS) was also implemented in 2014. The objective of the system is to track projects and activities at the organizational level and to monitor and report on their implementation status in support of the MTS.

In 2014 the Commission achieved two major milestones of the MTS. These were the implementation of an Enterprise Resource Planning (ERP) system that is compliant with the International Public Sector Accounting Standards (IPSAS) and the 2014 Integrated Field Exercise.

Finance

The 2014 Programme and Budget

The 2014 Programme and Budget was set at a level corresponding to slightly less than zero real growth. It maintained the split currency system (in US dollars and euros) for assessing the contributions due from States Signatories. This system was introduced in 2005 to lessen the exposure of the Commission to fluctuations in the value of the US dollar against the euro.

The Budget for 2014 totalled $42 517 500 and €65 006 500. At the budget exchange rate of €0.796 to $1, the total US dollar equivalent of the 2014 Budget was $124 189 000. This represented a nominal growth of 1.9% but was almost constant in real terms (a decrease of $52 300).

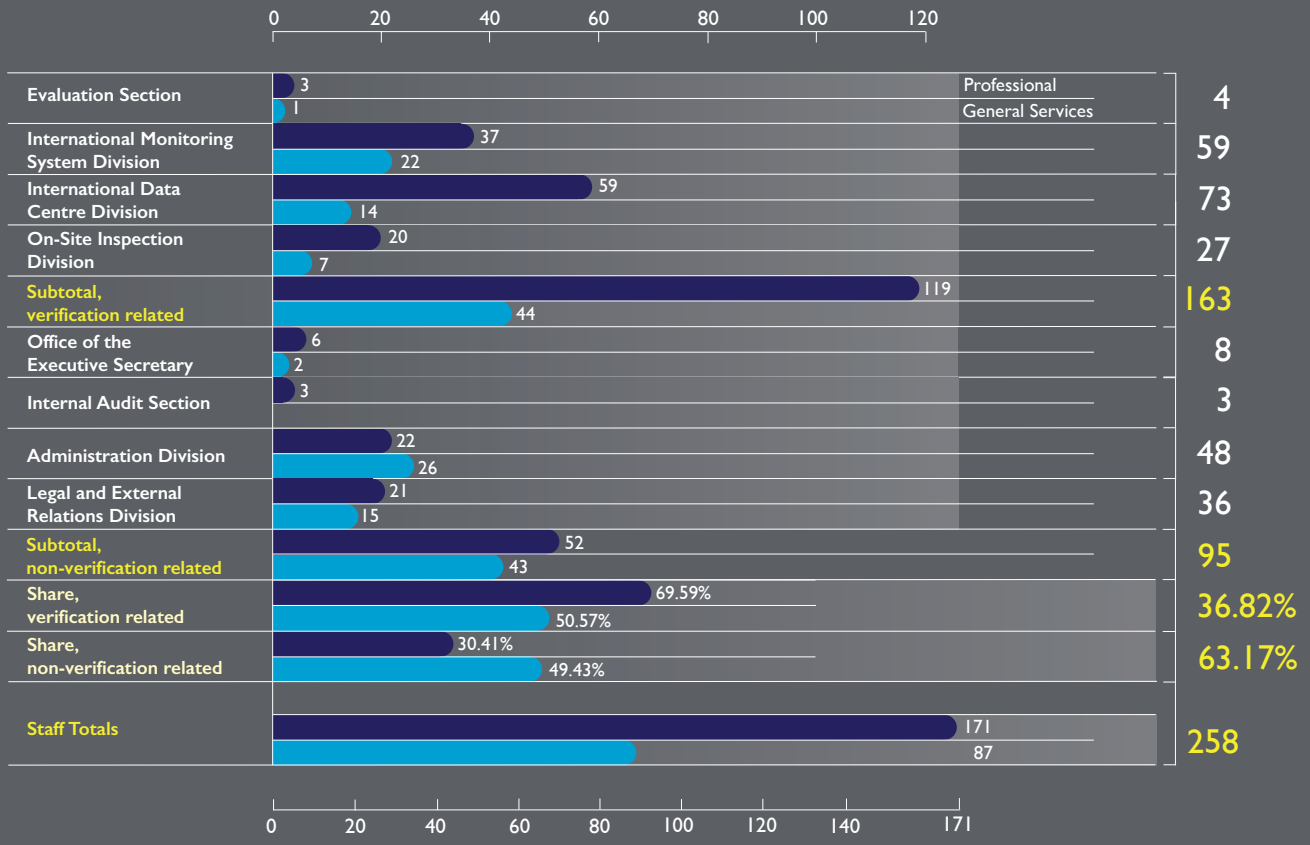
On the basis of the actual average exchange rate in 2014 of €0.7541 to $1, the final total US dollar equivalent of the 2014 Budget was $127 490 535. Of the total Budget, 79.3% was originally allocated to verification related activities. This included an allocation of $14 750 651 to the Capital Investment Fund (CIF), established for the build-up of the International Monitoring System. The remainder was allocated to the General Fund.

Assessed Contributions

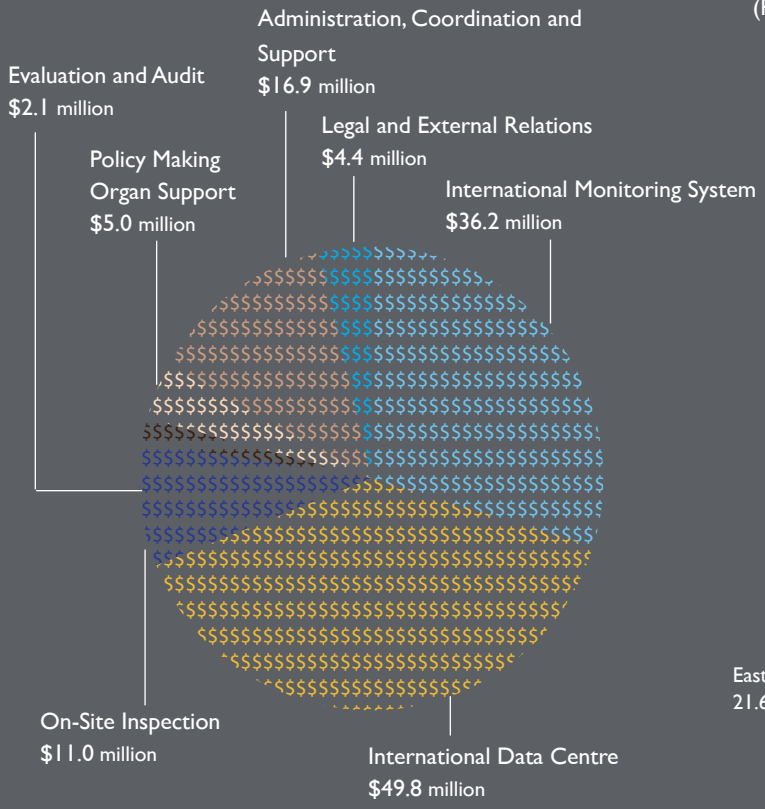
As of 31 December 2014 the collection rates of the assessed contributions for 2014 were 94.2% of the US dollar portion and 94.2% of the euro portion. In comparison, the respective 2013 collection rates as of 31 December 2013 were 96.4% and 96.3%. The combined collection rate of the US dollar and euro portions in 2014 was 94.6%, compared to 96.2% in 2013.

The number of States that had paid their 2014 assessed contributions in full as of 31 December 2014 was 101, compared with 99 in 2013. The collection rate of 2013 assessed contributions as of 31 December 2014 was 97.2%.

Regular Staff Members by Field of Work as of 31 December 2014



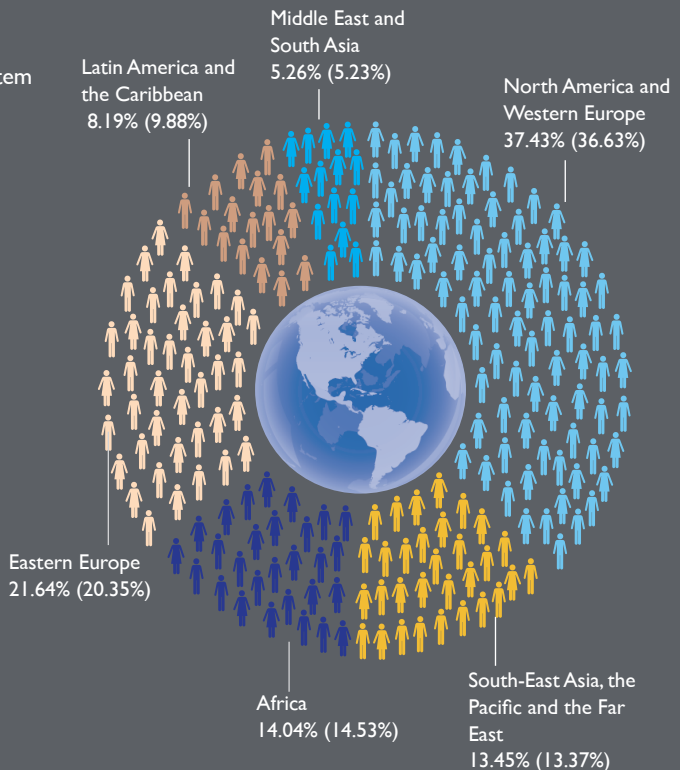
Distribution of 2014 Budget by Area of Activity



To convert the euro component of the 2014 Budget, an average exchange rate of €0.7541 to $1 was used

Staff Members in the Professional Category by Geographical Region as of 31 December 2014

(Percentages as of 31 December 2013 are shown in brackets.)



Expenditure

The expenditure for the Programme and Budget in 2014 amounted to $119 909 165, of which $17 284 989 was from the CIF. For the General Fund, the unused budget was $9 708 226, while approximately 37.3% of the CIF allotment was executed by the end of 2014.

Procurement

The PTS obligated $89 341 188 through 819 procurements for high value purchases and $1 301 755 through 847 contractual instruments for low value purchases. At the end of the year, there were 57 open requisitions for future obligation in the procurement pipeline with a total value of $2 967 706: $2 002 043 for the CIF and $965 663 for the General Fund.

As of 31 December 2014, 139 IMS stations, 11 radionuclide laboratories and the testing of 28 noble gas systems were under contract for testing and evaluation or for post-certification activities.

Voluntary Support Forum

The Executive Secretary initiated the Voluntary Support Forum (VSF) in 2014 as a forum for interaction with the donor community. The VSF aims to provide for transparent and proactive engagement with the donor community in order to mobilize voluntary contributions for extrabudgetary activities of the organization. The forum is identified as a key strategic enabler for improved management and coordination in the MTS for 2014–2017.

The VSF held two meetings in 2014, shortly after the sessions of the Commission in June and October. During the meetings, the participants received information on the projects for which the organization is seeking voluntary contributions and discussed their contributions to the strategic goals of the organization. The proposed projects ranged from strengthening the technical capabilities of the organization in measuring the background of radioxenon to integrated capacity building and outreach. The total amount sought for the projects for a period of two years was approximately $5 million.

Human Resources

The PTS secured the human resources for its operations by recruiting and maintaining highly competent and diligent staff. Recruitment was based on securing the highest standards of professional expertise, experience, efficiency, competence and integrity. Due regard was paid to the principle of equal employment opportunity, to the importance of recruiting staff on as wide a geographical basis as possible, and to other criteria stipulated in the relevant provisions of the Treaty and the Staff Regulations.

As of 31 December 2014 the PTS had 258 staff members from 76 countries, compared with 261 staff members from 79 countries at the end of 2013.

The Secretariat continued its efforts to increase the representation of women in the Professional category. At the end of 2014, there were 59 women in Professional positions, corresponding to 34.50% of the Professional staff. In comparison with 2013, there was an increase of 8.33% in the number of female staff at the P2 level and an increase of 10.53% at the P3 level. Female representation at the D1 and P4 levels decreased by 50% and 5.88%, respectively. Female representation at the P5 level remained the same.

Implementation of an IPSAS-Compliant Enterprise Resource Planning System

In a major achievement for the Commission, it completed implementation of an IPSAS-compliant Enterprise Resource Planning system within budget and on time.

The system has been in operation since May 2014 without notable problems. The system was stabilized during the remaining part of the year. The Commission also worked on establishing steady-state support and governance structure of the system.

Signature and Ratification Status as of 31 December 2014

183 Signed **161** Ratified **22** Signed but not ratified **13** Not signed

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

41 Signed **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
Iran (Islamic Republic of)	24 Sep. 1996	

State	Date of Signature	Date of Ratification
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

STATUS OF SIGNATURE AND RATIFICATION OF THE TREATY (31 DECEMBER 2014)

Africa

54 States:
51 Signatories
43 Ratifiers

State	Date of Signature	Date of Ratification
Algeria	15 Oct. 1996	11 Jul. 2003
Angola	27 Sep. 1996	
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
Cameroon	16 Nov. 2001	6 Feb. 2006
Cabo Verde	1 Oct. 1996	1 Mar. 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
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	
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 Signatories
23 Ratifiers

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 Signatories
31 Ratifiers

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

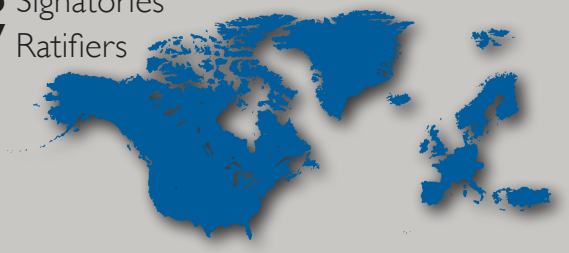
Middle East and South Asia

26 States:
21 Signatories
16 Ratifiers

State	Date of Signature	Date of 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:
28 Signatories
27 Ratifiers



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:
29 Signatories
23 Ratifiers

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
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	
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

FACILITIES OF THE CTBT INTERNATIONAL MONITORING SYSTEM

50 primary seismic stations
(PS20: details to be determined)

- PS Primary seismic array station
- PS Primary seismic three component station

120 auxiliary seismic stations
(AS39: details to be determined)

- AS Auxiliary seismic array station
- AS Auxiliary seismic three component station

11 hydroacoustic stations

- HA Hydroacoustic (T phase) station
- HA Hydroacoustic (hydrophone) station

60 infrasound stations
(IS28: details to be determined)

- IS Infrasound station

80 radionuclide stations
(RN35: details to be determined)

- RN Radionuclide particulate station
- RN Radionuclide particulate and noble gas station

16 radionuclide laboratories

- RL Radionuclide laboratory