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BACKGROUND DOCUMENT BY THE PROVISIONAL TECHNICAL SECRETARIAT OF THE PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION PREPARED FOR THE CONFERENCE ON FACILITATING THE ENTRY INTO FORCE OF THE CTBT (NEW YORK, 2023)

TREATY

1. The Comprehensive Nuclear-Test-Ban Treaty (CTBT) prohibits all nuclear weapon test explosions and any other nuclear explosion, whether for a military or any other purpose. It covers all environments and does not set a threshold from which the prohibitions should apply. The preamble of the Treaty states that its objective is "to contribute effectively to the prevention of the proliferation of nuclear weapons in all its aspects" and "to the process of nuclear disarmament".

2. The CTBT, and the international norm against nuclear weapon test explosions, have grown in strength since the adoption of the Treaty in 1996. In order to enter into force, the CTBT must be ratified by all 44 States listed in Annex 2 to the Treaty. These are the States which formally participated in the work of the 1996 session of the Conference on Disarmament, thus having contributed to the final stage of the negotiations on the CTBT, and which appear in one or both of the lists, compiled by the International Atomic Energy Agency (IAEA), of States with nuclear power reactors (as of April 1996) and of States with nuclear research reactors (as of December 1995).

3. Significant progress has been made towards the goal of entry into force and universalization of the Treaty. To date, the CTBT has been signed by 186 States and ratified by 178 States, including 36 of the 44 States listed in Annex 2. Since the 2021 Article XIV conference, Dominica, Equatorial Guinea, The Gambia, Timor-Leste,

Tuvalu, São Tomé and Príncipe, Solomon Islands and Sri Lanka completed their ratification procedures.

2021 ARTICLE XIV CONFERENCE

4. Under Article XIV, if the Treaty has not entered into force three years after the date of the anniversary of its opening for signature, a conference of those States that have already ratified it shall be held to decide by consensus what measures consistent with international law may be taken to accelerate the ratification process and to facilitate early entry into force. States which have signed but not ratified the Treaty will also be invited to attend the conference as observers.

5. The twelfth Article XIV conference[1] was held on 23 September 2021 in a virtual format with more than 88 States participating. In addition, several international and regional organizations attended. The conference adopted a Final Declaration calling upon all States which had not yet done so to sign and/or ratify the Treaty (CTBT-Art.XIV/2021/6, Annex). The declaration includes a number of measures to promote the entry into force of the CTBT.

6. In the course of the follow-up to the 2021 Article XIV conference, and in accordance with paragraph 10 (c) of the Final Declaration, Italy and South Africa, which served as the Presidency of the conference, were selected as coordinators of the process "to promote cooperation aimed at promoting further signatures and ratifications". Through a silence procedure which ended at 12:00 noon on 30 May 2023, Panama and Norway were appointed to serve as Presidents-designate in preparing for the 2023 Article XIV conference in New York.

PREPARATORY COMMISSION

7. In advance of the entry into force of the Treaty and the establishment of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), a Preparatory Commission was established by States Signatories on 19 November 1996. Its purpose is to carry out the necessary preparations for the effective implementation of the CTBT and to prepare for the first session of the Conference of the States Parties to the Treaty. Altogether 186 States are members of the Commission.

8. The Commission is tasked with undertaking all necessary preparations to ensure that the verification regime foreseen by the CTBT is capable of fulfilling its operational mission at entry into force, this includes, inter alia, the provisional operation of the International Data Centre (IDC) and the International Monitoring System (IMS). The Commission is made up of a plenary body responsible for directing policy and composed of all States Signatories, as well as a Provisional Technical Secretariat (PTS) which assists the Commission in its duties and carries out such functions as the Commission determines.

[1] Previous Article XIV conferences were held in Vienna (in 1999, 2003 and 2007) and in New York (in 2001, 2005, 2009, 2011, 2013, 2015, 2017, 2019 and 2021).

PROVISIONAL TECHNICAL SECRETARIAT

9. As of 31 July 2023, the PTS is comprised of 301 staff members from 90 countries. The number of staff at the Professional level was 201. The PTS is committed to a policy of equal employment opportunity, with a particular emphasis on improving the representation of women, especially in the scientific and technical areas within the Professional category. Eighty-three women held Professional positions as of 31 July 2023, corresponding to 41.3% of the Professional staff.

10. The approved Budget of the Commission for 2023 amounts to US$129.24 million. From 1997 up to and including the financial year 2023, the total budgetary resources amounted to $1613.23 million and €1061.82 million. In equivalent US dollars this corresponds to a total of $2890.74 million calculated using the budgetary rate of exchange of $1 = €0.831. Of this total, 79.9% has been dedicated to verification related programmes, including $524.97 million (around 18%) for the Capital Investment Fund for the installation and upgrade of IMS stations.

VERIFICATION REGIME

11. The CTBT provides for the establishment of a unique global verification regime that consists of an IMS, a consultation and clarification process, on-site inspections (OSIs) and confidence building measures. Data from IMS stations are to be sent via a secure global network (the Global Communications Infrastructure (GCI)) to an IDC for processing and analysis, and IMS data and IDC products are to be made available to States.

International Monitoring System

12. The IMS is to consist of a network of 321 monitoring stations and 16 radionuclide laboratories. The mission of these facilities is to produce data for the detection of nuclear explosions. These data are to be provided to States Parties for verification of compliance with the Treaty after entry into force.

13. As of 30 June 2023, 300 (93%) IMS stations had been installed, of which 291 had been officially certified as meeting the specifications of the Commission. In addition, since mid-2021, one primary seismic station (PS35) and one radionuclide station (RN2) were certified; also one more radionuclide laboratory (RL5) was certified for noble gas capability. As a result of political agreements and successful outreach activities, progress is being made in the establishment of stations in a number of States where there had been no or little progress. This will lead to additional IMS facility certifications in the coming years. Installation of additional noble gas systems will be a particular focus in the next few years. As of 30 June 2023, of the 40 noble gas detection systems envisaged by the Treaty, 32 had been installed, of which 26 systems have been certified (65%).

14. In addition, the continued political support from a number of countries hosting IMS facilities brings the prospect of a complete IMS network closer.

International Data Centre

15. The mission of the IDC is to support the verification responsibilities of States by providing data, products and services necessary for effective global monitoring after the entry into force of the Treaty.

16. The IDC continues in its provisional mode of operation and supports States Signatories by acquiring and forwarding continuous real time data, selected data segments and radionuclide spectra from the IMS. The IDC processes the IMS data along with compiled meteorological data and distributes the resulting products to support the verification responsibilities of States as well as their civil and scientific efforts. On average 14 terabytes of data and products are distributed every year. States are supported through an online help desk, data retrieval services, training courses, workshops and the provision of software and equipment.

17. The GCI is a closed network purposefully built to transport IMS data to the IDC and distribute the IDC product. The network is a hybrid mixing satellite, terrestrial and broadband technologies. This communication infrastructure covers over 100 countries and territories, with eight States Signatories operating a locally managed subnetwork. The network undergoes regular reviews, updates and refresh, to ensure that it remains secure and continues to provide very high data availability. The GCI is currently in its third generation.

18. Through the International Noble Gas Experiment, support from European Union Council Decision funds, contributions in kind from the United States of America (USA), and voluntary contributions from Japan, the PTS has been optimizing the capability of detecting signals from nuclear explosions against the global background of natural and human-made radionuclides. The overall goal is to enhance the detection capability of the IMS noble gas systems in order to make them as sensitive as possible to nuclear explosions.

19. The third phase of IDC seismic, hydroacoustic and infrasound (SHI) software re-engineering commenced in December 2018. This IDC-led effort to make the SHI processing platform modern, flexible, maintainable, updatable and traceable will include a new pipeline, improved analyst interface and state of health capabilities. The new system will integrate contributions from several States Signatories. The US government has donated releases of their Geophysical Monitoring Software, which is being developed for the modernization effort of the US National Data Centre (NDC); much of the software is fully compatible with PTS requirements. The IDC is using this software as a baseline and adding IDC specific components. Five releases have been received, the latest in March 2023; this release contains state of health capabilities, and the IDC is currently in the process of integrating the application and enhancing it with a few IDC specific requirements. In addition, the IDC received new threshold monitoring software from the Norwegian NDC and is doing final testing and integration of this software into the re-engineering platform; this updated software provides detailed information and graphics showing the detection capability of the IMS network.

20. The IDC is now prepared to automatically process data from the next generation noble gas systems. Over the last several years, radionuclide data processing software was also

modernized, and will achieve the same goals of having modern, maintainable, code. In addition, software was developed and enhanced in a coordinated approach to enable a single software platform to handle both particulate and noble gas processing and unify the software used at the IDC and in NDCs. The new interactive analysis software is in its final testing and is expected to go into operation soon.

21. Infrasound analysis capabilities were enhanced in July 2022 upon replacement of the legacy system into IDC operation with the redesigned station processing and interactive analysis software DTK-(G)PMCC that is based on the Progressive Multichannel Correlation method, developed in partnership with the French NDC.

22. Since 2021, the PTS released major upgrades of both the radionuclide and the SHI data analysis software provided to NDCs. In addition, the release process was modernized to enable NDCs to install and update their software more easily. The project was supported financially through EU Council Decision V, VI, VII and VIII. The new version of the software enables NDCs to combine IMS data and IDC products more easily with data from local and regional stations and from other global networks. In addition, atmospheric transport modelling analysis software has been updated. The PTS continuously enhances and extends the capabilities of software for NDCs.

Sustaining and Maintaining the International Monitoring System

23. In accordance with Article IV of the Treaty, the PTS supervises, coordinates and ensures the operation of the IMS and its component elements. Preparing a global verification regime is not just about building stations. It is about taking a holistic approach to establishing and sustaining a system that meets the verification requirements of the Treaty and ensures minimal downtime of IMS facilities. Operational experience with the system has increased over time, leading to the establishment of an IMS sustainment structure and concerted efforts for more effective operations, preventive maintenance, logistical and engineering strategies and programmes. These sustainment activities are essential to preserve the investment already made by States Signatories.

24. The PTS has continued its activities in configuration management, supportability analysis, establishment of equipment support contracts, shipping and customs clearance and equipment sparing in support of improving IMS station operability and uptime. It has also continued to recapitalize IMS facility components reaching the end of their operational lives and to address unscheduled maintenance in a timely fashion. Furthermore, owing to the central role played by station operators in resolving problems on site and hence contributing to high levels of data availability, the PTS has continued to invest in training courses for station operators that are tailored to their needs. Monitoring and tracking software has been enhanced to further facilitate the tasks of monitoring, detecting and resolving incidents in the IMS network.

25. As the IMS network grows the costs associated with its sustainment also rise. Since March 2023 the PTS has embarked in designing a new strategy towards sustainment following a two-pronged approach. The first stage constitutes the immediate IMS needs for the 2024-2025 budget cycle. The second stage involves an analysis of the current status of the network and envisions a mid to long term planning for sustainment.

26. Operation and maintenance of IMS auxiliary seismic stations are the responsibility of the host countries. While some progress has been made over the last two years, resulting in maintained levels of data availability and a better understanding of roles and responsibilities for sustainment, further efforts involving close collaboration with States Signatories are required. Some States Signatories and the European Union provide voluntary contribution for IMS auxiliary seismic stations hosted by developing countries or countries in transition that do not belong to parent networks in need of repairs and recapitalization.

27. Increasing the number of facility agreements and arrangements between the Commission and the States hosting IMS facilities is important for providing the required support for the functioning and sustainment of the IMS. As of 31 July 2023, facility agreements had been signed with 49 of the 89 host States, and 41 of these agreements had entered into force. The development and implementation of mechanisms such as timely customs clearance and tax exemption for equipment brought into an IMS host State has proven to be highly relevant.

28. The PTS has continued to focus on engineering and development activities with the aim of improving the robustness of IMS monitoring facilities and enhancing the performance and capabilities of associated technologies. This is being achieved through designing, validating and implementing solutions throughout the life cycle of IMS stations. Notably, grounding and lightning standards that were updated to international standards are being progressively implemented throughout the IMS, and new guidelines for power at IMS stations and type approval procedures for critical equipment used at IMS installations are under development.

29. Significant progress has been made in the quality assurance/quality control (QA/QC) programme of the IMS network. Calibration of primary and auxiliary seismic, T phase stations and infrasound stations are scheduled and performed on an annual basis with the support of station operators. Similarly, a comprehensive QA/QC programme is in place for all radionuclide stations. In addition, testing and implementation of pilot QA/QC procedures for radionuclide stations with noble gas capability has continued with good results and in 2021 the first noble gas Proficiency Test Exercise was held with the participation of six IMS laboratories.

30. Up to date and reliable technical documentation for each IMS station is essential to ensure its sustainability and to maintain a high level of data availability. The PTS continues to make progress populating its Quality Management System (QMS) with station specific documentation.

31. There are currently two major technological developments in progress: (i) the next generation of noble gas systems that have improved sensitivity and enhanced reliability are under development, testing and implementation. One type of noble gas system has completed all testing and the first of its kind is now being installed at radionuclide station RN63; (ii) a hybrid modular design concept was identified as the optimal approach to enable reparability of individual nodes and underwater system subcomponents of hydroacoustic hydrophone stations. A first prototype modular cable latch that enables the disconnection of a node from the trunk or internode cable any time after deployment

without disturbing the other elements of the underwater triplet is complete and is ready for testing.

32. Significant efforts and re-engineering of the information technology infrastructure has ensured high availability of all information technology equipment and systems in use. For instance, the availability of infrastructure supporting critical IDC verification capabilities was 99.9% for the period January to June 2023. Through a combination of different approaches, including redundancy, secure storage and clustering, the effects of hardware failure and human error have been minimized.

33. High levels of data availability from IMS stations are being achieved. This has been achieved through the operation and sustainment strategy of the PTS and the joint efforts with delegations, national governments, station operators and national institutions. In 2022, the data availability levels remained high for certified IMS stations with average data availability of 91.66% for the primary seismic station network, 99.34% for the infrasound station network, 91.11% for the hydroacoustic station network and 83.46% for the auxiliary seismic station network. The radionuclide network performed at data availability levels of 96.41% (particulate stations) and 92.96% (noble gas systems) in 2022.

34. Post-certification activity contracts, agreements and arrangements support station operators in operating and maintaining primary SHI and radionuclide IMS stations, and noble gas systems after certification. There are post-certification activity contracts in place for 168 certified IMS stations and noble gas systems. The PTS has developed standardized operation and maintenance plans, which by the end of 2022 had been implemented by 139 stations. This approach helps to keep operational costs at a reasonable level while ensuring sufficient funding to keep the stations well maintained. Keeping the operational costs of IMS stations at a reasonable level is a joint responsibility of the PTS and the host country.

On-Site Inspections

35. On-site inspections represent the ultimate verification measure of the CTBT in order to address possible compliance concerns with the Treaty. An OSI can only be invoked after the entry into force of the Treaty. The sole purpose of OSI is to clarify whether a nuclear weapon test explosion or any other nuclear explosion has been carried out in violation of the Treaty and to gather facts which might assist in identifying any possible violator.

36. The Commission has continued to build up the OSI verification regime in accordance with Treaty requirements. Considerable progress has been made with the completion of the OSI action plan and of the third training cycle for inspectors.

On-Site Inspections Programme of Work

37. The OSI programme of work 2022-2023 builds on the significant progress made under the OSI action plan 2016-2019. The programme of work was developed in the context of the OSI strategic plan and the Programme and Budget for 2022-2023. A new OSI programme of work 2024-2025 has recently been published which emphasises the work of the Division on the successful implementation of ongoing OSI exercise programme.

On-Site Inspection Exercise Programme

38. The OSI exercise programme for 2022-2025 was approved by the Preparatory Commission in June 2022. The programme includes a series of increasingly challenging exercises including three directed exercises in 2023, two tabletop exercises for Senior Management, and a build-up exercise (BUE) in 2024 and an Integrated Field Exercise (IFE) in 2025.

39. BUE24 is expected to be conducted in Hungary and will focus on the integrated application of OSI techniques during a continuation period in a mountainous environment.

40. Following a rigorous assessment of candidate host countries, from technical, operational, health and safety, security, financial and legal perspectives, the Executive Secretary recommended that the Preparatory Commission approve Sri Lanka as the IFE host country, which it subsequently did at its resumed session on 21 July 2023. IFE25 is expected to last approximately six weeks, will involve around 180 participants and require shipment of more than 120 tonnes of equipment.

41. Several specialist task forces have been established to support the programme implementation, including an external scenario task force charged with the development of technically realistic, temporally logical, scientifically credible and challenging scenarios for both the in BUE24 and IFE25

Inspectors Training Programme

42. Development of the OSI training programme commenced in early 1997 to initially investigate the requirements for inspectors working within the confines and requirements of the Treaty. Over the years the training programme has built on these early efforts and developed into a robust programme with the successful completion of the first, second and third training cycles.

43. The PTS has established a roster of about 171 surrogate inspectors. These experts have been nominated by States Signatories or designated PTS staff and have successfully completed the first, second or third training cycles. Surrogate inspectors remain on the roster as long as their designations by the nominating States remain unchanged, their skills and knowledge are refreshed and they are physically fit.

44. It should be noted that since its inception the inspector training programme has progressed in conjunction with the development of the draft OSI Operational Manual and the draft OSI methodologies, techniques, procedures and equipment. The development of the programme can be categorized into four major periods:

    1. 1997-2001: Development of the experimental training and exercise programme;
    2. 2001-2006: Development of the long range plan for the OSI training and exercise programme;
    3. 2007-2021: Execution and refinement of the first, second and third training cycles;

4. 2022 – present: Execution of the linear training programme.

45. The next generation OSI surrogate inspector training programme (linear training programme) is a further development of the OSI training programme that builds upon the three previous training cycles and mimics an inspector training programme upon entry into force. It is a linear (vs cyclical) model that follows the modular structure of the third training cycle but integrates the training of newly inducted trainees with the skills and maintenance training (refresher) of existing surrogate inspectors on the roster. It incorporates some modifications and improvements on the basis of lessons learned during the previous training cycles and the training needs analysis undertaken at an expert meeting following the conclusion of the third training cycle. Furthermore, the linear programme can be repeated as necessary for testing and validation purposes and improved on the basis of experience until entry into force.

46. The linear training programme officially kicked off with a refresher course in November 2022, followed by a call for new nominations from all States Signatories and subsequent intake of inspectors during the regional introductory courses. The announced objective of 50 new nominations was reached before the nomination deadline of 20 June 2023. As of this reporting period, 76 nominations from 30 States Signatories were received. The gender balance for OSI inspector training continues to improve, with 37% of the nominations represented by female experts (vs. 30% for the third training cycle).

47. In the next generation linear training programme, face to face training activities are heavily supplemented with distance learning activities such as e-learning courses, step by step video tutorials, remote software training and so on, which increases programme flexibility in delivering its objectives.

SIX ANNOUNCED NUCLEAR TESTS BY THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

48. The accuracy of the location identified by the IDC based on primary and auxiliary seismic stations of the IMS depends on the number of detections contributing to it. For the nuclear tests announced by the Democratic People's Republic of Korea, this number increased from 22 for the DPRK-1, conducted on 12 October 2006 with mb (IDC)=4.08, to 189 stations for the DPRK-6, conducted on 3 September 2017 with mb (IDC)=6.07. This increase is due to both a larger number of certified stations in 2017 and to the higher magnitude of the DPRK-6 test. Correspondingly, the confidence ellipse area decreases from 880 square kilometres for DPRK-1 to 109 square kilometres for DPRK-6.

49. Aftershock activity continued in the test area of the Democratic People's Republic of Korea . More than 50 aftershocks have been detected and analysed during the period from the last test in 2017 until now. The most recent aftershocks were detected in June 2023.

50. The performance of the verification system was timely and effective and proved the value of the investment made in its establishment.

51. The announced tests were detected by the IMS facilities and the data were shared with States Signatories in near real time. The States Signatories received the reviewed data

products within the defined timelines. The Commission also held briefings to discuss the findings of the verification system.

52. The response of the IMS and the IDC to the announced tests established that their capabilities are nearing full maturity. In addition, the tests underlined the significance of the OSI mechanism as a complementary element of the verification regime and the need for constant testing and validation of the regime.

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

QUALITY ASSURANCE AND PERFORMANCE MONITORING

54. The PTS undertakes to continuously enhance effectiveness and efficiency through its QMS, which encompasses all contributing PTS processes and work products. One of the functions of the QMS is to identify and implement key performance indicators for evaluating these processes and products and assure the development of a continual improvement process in the PTS with focus on the verification regime. The overall aim of the QMS is to support the objective of consistently meeting verification system requirements.

55. The performance monitoring and testing framework was established by the PTS to create a culture in which quality is monitored as part of normal activities so that stakeholders, such as States Signatories and NDCs, have assurance that the Commission is in compliance with the requirements set forth in the Treaty and its Protocol. As part of this process, NDCs, which use the products and services of the IDC, meet in annual workshops to provide their feedback, and representatives from States Signatories are invited to participate in activities organized by the PTS, such as OSI exercises or experiments conducted by the IDC.

56. Exchanges of experience and knowledge have been reached through a series of NDC Preparedness Exercises (NPEs) conducted by the NDCs and will continue in the future. NPEs represent a further advance along the learning curve for NDCs to perform their verification duties, enhancing the dialogue and cooperation between experts in the various CTBT monitoring technologies and the PTS.

CTBT: SCIENCE AND TECHNOLOGY CONFERENCES

57. Mindful of the obligation under Article IV of the Treaty that States Parties cooperate with the CTBTO "in the improvement of the verification regime, and in the examination of the verification potential of additional monitoring technologies", the CTBT: Science and Technology (SnT) process was established in 2006 to engage with the global scientific and technological research community.

58. This process continued in June 2023 with the seventh in a series of biennial SnT conferences hosted by the Commission in the Hofburg Palace, Vienna, with support from the European Union[2]. Over 2000 participants from around 150 countries registered to participate in SnT2023, with 80% indicating in-person attendance while the others made use of the online access. The Executive Secretary opened the conference alongside a diverse group of high level speakers at Ministerial, Agency Head, Senior Official and Expert level. This high level segment provided a political and diplomatic context. Key themes of that segment, which permeated the entire conference, were inclusion, unity, universalization and harnessing the benefits of the IMS for all. 'The Power of Together' emerged as an overarching motto.

59. The scientific programme featured 102 oral presentations, 455 electronic posters, 16 panel discussions, including panels held in Arabic, French and Spanish, and an opening session with high level invitees setting a political and diplomatic context. The conference provided a forum for the Commission to maintain awareness of emerging technologies relevant to CTBT verification. It explored methodologies for monitoring the performance of the verification regime and considered topics related to capacity development and the education and training of those who contribute to the installation and maintenance of relevant monitoring facilities and to data processing and analysis. It also put special emphasis on the active participation of early career scientists and the CTBTO Youth Group (CYG). The session videos are available on the CTBTO YouTube Channel. All conference materials can be found on the event portal at https://ctbto.org/SnT2023.

60. The conference covered the following five themes: 1. The Earth as a Complex System, 2. Events and Nuclear Test Sites, 3. Monitoring and On-Site Inspection Technologies and Techniques, 4. Sustainment of Networks, Performance Evaluation and Optimization, 5. CTBT in a Global Context. Special highlights included the response to the Hunga Tonga–Hunga Ha'apai volcano eruption on 15 January 2022, new primary measurement standards for infrasound and for low frequency seismic measurements to provide of measurement traceability, achievements and challenges of noble gas monitoring, and preparations for the on-site IFE25 that will take place in Sri Lanka. Special emphasis was put on the benefits that all CTBT States Signatories gain from the access to data of the IMS for Treaty verification and for civil and scientific applications as well as from related capacity building and training.

INTEGRATED CAPACITY BUILDING AND TRAINING

61. The Commission accords high importance to training and capacity building to improve the capacity of States Signatories to effectively fulfil their verification responsibilities under the Treaty and to benefit fully from their participation in the verification regime, in particular through the use of IMS data and IDC products (for verification as well as for their own civil and scientific applications).

62. In addition to traditional training methods, information and communication technologies such as e-learning offer broader possibilities to expand and further enhance capacity

[2] European Union funds were used mainly to support the participation of presenters, speakers and young professionals at SnT2023.

building. Training and capacity building are provided to States Signatories that have access to IMS data and IDC products (around 1760 authorized users from 146 States) as well as to those that do not have access (40 States) and those that do have access but make limited use of the information.

63. The training targets a variety of audiences, namely IMS station operators, technical staff of NDCs, OSI inspectors, officials, diplomats and PTS staff. Currently, 51 e-learning modules, in the official languages of the United Nations, are available. Since 1999, more than 11 500 NDC technical staff and IMS station operators from 186 States Signatories were trained. The current training programme includes around 35 NDC and station operator events annually, for all four technologies.

64. The need to invest in the next generation of nuclear non-proliferation and disarmament specialists is a key driver of the education activities of the Commission. These aim to broaden knowledge of the Treaty and to develop capacities in States Signatories to effectively confront the political, legal, technical and scientific challenges facing the Treaty and its verification regime. To achieve this objective, the Commission continued to develop its Knowledge and Training Portal, complete with issue specific training modules, a database of CTBT related resources and materials, and an archive of lectures on the Treaty and the science and technology that underpin its verification regime. The Commission is also the first security based international organization to create a free and open educational platform on iTunes U, which allows users to access and download lectures, documents and presentation files on the policy, legal, technical and scientific aspects of the CTBT.

65. The Commission also continued to update and to modernize its publicly available CTBT e-learning modules and introductory CTBT tutorial using a modern and interactive e-learning framework. This set of newly developed modules will help to prepare stakeholders for the CTBTO educational initiatives, support outreach activities, and improve the CYG induction mechanism on its portal. The modules will also be utilized for awareness raising and outreach to the general public, and can be made available for incorporation into academic curricula.

OUTREACH ACTIVITIES

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

67. Most interaction with States to raise awareness about the Treaty and promote signature and ratification takes place in the context of bilateral consultations and correspondence. While special emphasis has been placed on those States listed in Annex 2 to the Treaty and those hosting IMS facilities, virtually all States have been approached in the Commission’s outreach efforts since September 2021. In addition to regular dialogue with Permanent Missions in Vienna and those representations based in Berlin, Geneva and New York, visits by PTS staff were conducted in a number of capitals.

Consultations were also held, at all levels, on the margins of global, regional and subregional conferences and other gatherings.

68. A number of missions, events and activities are organized by the PTS which allow for bilateral consultations with participants from both signatory and non-signatory States. PTS outreach missions to Dominica (February 2022), Timor-Leste (March 2022), São Tomé and Príncipe (April 2022), Equatorial Guinea (July 2022), Solomon Islands (November 2022), Papua New Guinea (November 2022), South Sudan (February 2023), Somalia (February 2023), Sri Lanka (May 2023) and Nepal (June 2023) were led by the Executive Secretary. These have contributed to the surge in momentum towards universalization of the Treaty since September 2021.

69. The Commission continued to take advantage of global, regional and subregional conferences and other gatherings to enhance understanding of the Treaty and to advance its entry into force and the build-up of the verification regime. The Commission was represented at meetings of e.g. the African Commission on Nuclear Energy (AFCONE), the African Union, the European Union, the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL), the International Atomic Energy Agency (IAEA), the International Organization of the Francophonie (OIF), the Inter-Parliamentary Union (IPU), the League of Arab States (LAS), the Organization for the Prohibition of Chemical Weapons (OPCW), the United Nations Office in Geneva (UNOG); the United Nations Office at New York (General Assembly and First Committee) and the United Nations Office for Disarmament Affairs (UNODA).

70. During these meetings and conferences, the Executive Secretary met with a number of heads and other senior officials of international and regional organizations including the Director-General of the IAEA, the Secretary General of the IPU, the President of the IPU, the Secretary-General of the United Nations, the High Representative for Disarmament Affairs of the United Nations, the President of the United Nations General Assembly, the Director-General of UNOG, the Director-General of the United Nations Office at Vienna/Executive Director of UNODC, the Chairperson and the Executive Secretary of AFCONE, the Secretary General of the OIF, the Secretary General of the LAS.

71. Participation by the Executive Secretary in major events and high level bilateral talks constitutes a key element of PTS outreach efforts. These included the following: 5th Conference of States Parties to the Pelindaba Treaty (October 2021); Wilton Park Conferences (November 2021 and December 2022); EU Conference on Non-Proliferation and Disarmament (December 2021); OPANAL event marking 55th Anniversary of the Treaty of Tlatelolco (February 2022); Munich Security Conference (February 2022); Conference on Disarmament (March 2022); 144th Assembly of the Inter-Parliamentary Union (March 2022); XXII Edoardo Amaldi Conference on Nuclear Risks and Arms Control (April 2022); 10th Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (August 2022); high level meetings of the United Nations General Assembly Sessions to mark the International Day against Nuclear Tests (September 2022 and August 2023); 77th session of the United Nations General Assembly (September 2022); high level Friends of the CTBT Meeting (September 2022); 36th African Union Summit (February 2023); Hiroshima and Nagasaki Peace Memorial Ceremonies (August 2023); Preparatory Committee for the 2026 Review Conference of

the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (July/August 2023).

72. The Executive Secretary also attended a range of other conferences, meetings and seminars where he gave keynote speeches or participated in panels or discussions on the Treaty. During these conferences, meetings and seminars around the world and at meetings in Vienna, the Executive Secretary met with prominent figures from academia, leading think tanks and other non-governmental entities. He also attended events related to nuclear non-proliferation and disarmament convened by individual governments.

73. The PTS has continued to promote preparations for national implementation of the CTBT through its programme of legislative assistance to States on the measures to be taken in accordance with Article III of the CTBT. Model legislation and commentary are available on the CTBTO public web site.

74. As part of its outreach programme, the CTBTO held its third Science Diplomacy Symposium in December 2022 to build upon the momentum towards universalizing the Treaty created during its 25th anniversary year, promote the equitable distribution of benefits to States from participation in the verification regime, and to raise awareness of the contribution of the CTBT to international peace and security. The event was held in a hybrid format with a range of high level speakers addressing current issues with over 260 participants from across the globe.

75. The PTS has also continued to promote the Treaty and its verification regime among States, media, civil society, educational and scientific institutions, think tanks and the general public using a strategic and targeted approach. During the reporting period, public information activities generated considerable media coverage for key events, including the CTBT: Science and Technology 2023 conference, recent ratifications and engagements of the Executive Secretary. In 2022 the CTBTO corporate website was completely redesigned to provide a more immersive and easier to navigate experience for stakeholders. Engagement with traditional media outlets has resulted in increased visibility for the Treaty and the verification regime in print, online and broadcast media worldwide, while social media platforms are routinely used to highlight the importance of the Treaty to international peace and security and the contributions of States Signatories to the verification regime. Media outreach and other public information activities have continued in the form of information materials in all official languages, articles, op-eds, interviews, briefings, publications, special events, exhibitions and presentations.

76. A significant portion of the outreach activities of the Commission is carried out using voluntary contributions provided by States Signatories. Among the activities conducted by the PTS on the basis of such contributions was the project facilitating the participation of experts from developing countries in technical meetings of the Commission, funding the maintenance and operation of auxiliary seismic stations in developing countries, thus enhancing the data processing capabilities and data availability for States Signatories. Voluntary contributions have also been provided for training to build capacity in developing countries and to enhance understanding of the work of the Commission with a particular focus on the young generation including the expanding CYG, applications and development of the CTBT verification technologies and the benefits accruing from

membership of the Commission, including the potential benefits derived from the civil and scientific applications of the verification technologies.

CIVIL AND SCIENTIFIC BENEFITS OF THE TREATY

77. There are a range of civil and scientific applications for the verification technologies of the Treaty that can benefit States Signatories. The abundance of data and products available to States Signatories can facilitate their civil and scientific activities, including, for example, natural disaster warning and preparedness, sustainable development, climate change research, knowledge expansion and human welfare. Since 2011 a total of 192 contracts have been signed, providing researchers from 30 countries free access to IMS data through the virtual Data Exploitation Centre.

78. As an example of the civil and scientific applications of the verification technologies, the Commission has agreed on terms under which IMS seismic and hydroacoustic data can be made available to recognized tsunami warning organizations. Twenty such agreements or arrangements with 19 countries are currently in place for which data from approximately 120 IMS stations are being sent. Tsunami warning organizations have confirmed that the use of IMS data, which are timelier and more reliable than data from other sources, increases their ability to identify potentially tsunamigenic earthquakes and to issue more rapid warnings.

79. The 15 January 2022 eruption of Hunga Tonga-Hunga Ha’apai, Tonga, ranks as the most energetic volcanic explosion on Earth since the 1883 eruption of Krakatau (Indonesia). The eruption's powerful acoustic gravity waves circled around the Earth for several days, and it was recorded globally by all three IMS waveform monitoring technologies: seismic, infrasound and hydroacoustic making it a benchmark event for the IMS network capability.

CONCLUSION

80. Since the 2021 Article XIV conference, considerable progress has been achieved in the promotion of the Treaty and the advancement of its verification regime. The continued call for urgent entry into force has featured prominently in the agenda of the international campaign for nuclear non-proliferation and disarmament and has led to a surge in progress towards universalization. The verification regime of the Treaty has moved closer to completion, further improving its operational readiness and thereby increasing the confidence in its capability to detect any nuclear explosion test in any environment.