The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans all nuclear explosions.

It opened for signature on 24 September 1996 in New York.

As of mid-2016, 183 States have signed the Treaty and 164 have ratified it. Of the 44 nuclear capable States which must ratify the CTBT for it to enter into force, the so-called Annex 2 countries, 36 have done so while eight have yet to ratify: China, the Democratic People’s Republic of Korea, Egypt, India, Iran, Israel, Pakistan, and the United States.

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) consists of the States Signatories and the Provisional Technical Secretariat. The main tasks of the CTBTO are to promote signatures and ratifications and to establish a global verification regime capable of detecting nuclear explosions underground, underwater, and in the atmosphere.

The regime must be operational when the Treaty enters into force. It will consist of 337 monitoring facilities supported by an International Data Centre and on-site inspection measures. As of mid-2016, roughly 90 percent of the facilities of the International Monitoring System (IMS) are established.
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The CTBT at 20: Let’s Finish What We Started

LASSINA ZERBO
Executive Secretary of the CTBTO

On this, the 20th anniversary of the open- ing for signature of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), it is my pleasure to present this brief history of the Treaty. The work of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) also detailed here, provides a flavour of the organization’s endeavours in supporting the entry into force of the Treaty.

Over the past 20 years, the CTBT has proven successful in curbing nuclear testing. Compare the 2,000 nuclear explosions conducted in the decades before 1996 to the handful after 2011, these few constitute a serious challenge to the Treaty’s non-test norm. With the nuclear weapons tests of the Democratic People’s Republic of Korea, the need for the Treaty’s enforcement to promote international peace and security has been brought into sharp focus. Indeed, the CTBT needs to enter into force as soon as possible to tackle some of the gravest threats to international security today.

In 1997, when the CTBT was being formed, the first Executive Secretary, Wolfgang Hoffmann, set out with the Herculean task to construct the International Monitoring System (IMS), the most ambitious verification regime in treaty history. Over the years, doubts about the capability of the IMS to do what it was designed to do – detect any nuclear explosion anywhere – have been voiced within some countries as a reason not to ratify the Treaty. Today, these concerns no longer hold weight. Currently, with over 300 IMS facilities worldwide monitoring seismic, infrasound, hydroacoustic, and radionuclide signals, there is simply nowhere on earth to test a nuclear weapon without the CTBTO detecting it.

In addition, the Integrated Field Exercise held in Jordan in 2014 demonstrated that the IMS is coupled with a robust on-site inspection capability that can provide incontrovertible evidence of whether a nuclear explosion has occurred or not. We have mastered all components of the verification regime. It is political will, rather than scientific capability, which now holds the Treaty back from entering into force.

As the IMS network grew, and the data from the network started to flood into our International Data Centre, we realized unexpected benefits from what was being received. Not only did the network exceed international expectations and requirements, but the data collected could also be used for disaster warning and scientific research. Working with our Member States and their respective National Data Centres, we have been able to put the IMS to work for the good of the environment and for human safety also.

For instance, when the devastating Indian Ocean earthquake of 2004 triggered a lethal tsunami, IMS stations picked up on the signals of the event. Through building on the technology and data processing capabilities, the CTBTO has now been able to sign 14 tsunami warning agreements to provide real-time tsunami warning data to Member States. When the Tohoku earthquake of 2011 caused a tsunami that devastated the north-eastern seaboard of Japan, the CTBTO was able to provide data to help disaster mitigation efforts. In addition, after the tsunami caused the cooling systems to fail at the Fukushima Daiichi nuclear power plant, the IMS was able to track the spread of radioactivity from the site. During this time, the CTBTO worked closely with the International Atomic Energy Agency and the World Health Organization to aid the crisis response. To quote United Nations Secretary-General Ban Ki-moon, “Even before entering into force, the CTBT is saving lives”. I could not agree with him more. But the CTBTO would not be the organization it is today without the support, and work, of the people with whom the organization engages. The Group of Eminent Persons (GEM), launched in 2013, brings together prominent personalities and internationally recognized experts to provide an innovative and focused approach to advancing the CTBTO’s ratification by the remaining eight Annex 2 States. The GEM’s adoption of the Hiroshima Declaration in 2015, 70 years after the atomic bomb was used at that location, sets out 8 key points to achieve the Treaty’s entry into force.

Looking to the future, I have been greatly encouraged by the ideas to bring the CTBT into force from the discussions I have had with young students and diplomats. In 2016, we launched the CTBTO Youth Group to foster and engage young students and graduates. This group is open to young people who are directing their careers to contribute to global peace and security and who wish to engage in promoting the Treaty. I am confident that we are passing the baton to a generation who will tackle the challenges associated with the CTBT with innovation and vigour.

This brochure illuminates these topics and highlights the work of my colleagues who work tirelessly to ensure the CTBTO is ready to fulfil its role once the eight remaining Annex 2 States ratify the Treaty. Many CTBTO personnel brave the elements in all corners of the globe to ensure that no nuclear test goes unmonitored. It is through the commitment of our staff that the international community now has the option to verify an end to nuclear testing.

Let us not have another anniversary without the CTBT being the global norm in banning nuclear tests. To cite our motto for the year, “Let’s finish what we started.”

»We cannot really characterize this anniversary as a cause for celebration. Until such time as it enters into force, the CTBT is unfinished business. Unless we finish what we started, there is a risk that we will lose twenty years of hard work and fifty to sixty years of negotiations on a world without nuclear testing. So the twentieth anniversary is a time for reflection. And hopefully that reflection will bring about a time for action.«
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As 2016 marks the CTBT’s 20th anniversary of opening for signature, this provides a unique occasion to step back and reflect on what has been achieved so far. In 1996, after tough negotiations in Geneva, the CTBT began its journey of seeking entry into force.

During the last century, over 2,000 nuclear tests were conducted at locations around the globe. As the pace of nuclear testing increased during the Cold War, the damage done to international security, the environment, and human health drew global condemnation, and led to the question of how nuclear testing could be abolished.

The Partial Test Ban Treaty (PTBT), opened for signature in 1963, laid the foundation for banning nuclear tests. However, the PTBT only banned nuclear testing in outer space, the atmosphere, and underwater—not underground. Furthermore, the PTBT did not have a global verification system and relied on national monitoring techniques to ensure adherence. A comprehensive regime was therefore required and recognized in the preamble of the Nuclear Non-Proliferation Treaty (NPT) in 1968; the NPT compels its 191 Member States to “seek to achieve the discontinuance of all test explosions of nuclear weapons for all time and to continue negotiations to this end.”

In the early 1970s, the Conference on Disarmament (CD) commissioned a Group of Scientific Experts to explore technologies and data analysis methods for an independent, and internationally controlled, verification system for nuclear testing. Over the next 20 years, this scientific groundwork, coupled with political will garnered through the Ad Hoc Committee on a Nuclear Test Ban, produced the international consensus required for the commencement of CTBT negotiations in 1994. Between 1994 and 1996, tough negotiations took place to establish, among others, the monitoring and inspection of the Treaty, its entry into force, and a supporting organization’s mandate. On 22 August 1996, Belgium submitted the final CTBT text to the CD as a national paper that, in turn, allowed the CD to forward the Treaty to the United Nations General Assembly.

The first meeting of the Preparatory Commission of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) convened in November 1996. Since 1997, the CTBTO has implemented the verification regime, as well as worked to promote ratification, so that the Treaty can finally enter into force.

Banning the Bang – Creating the CTBT

The only major area of nuclear non-proliferation and disarmament negotiations where the end is in sight, yet where a fresh start is badly needed, is in a treaty to outlaw nuclear tests.«

JOHN F. KENNEDY
35th President of the United States (1961)

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Australia, along with 127 co-sponsors, introduced a resolution containing the Treaty text to the United Nations General Assembly on 9 September 1996. Only 3 countries voted against the resolution, 5 abstained, and 158 voted in its favour. After the vote, United States President Bill Clinton remarked, “We’re taking the next crucial step to lift the dark cloud of nuclear fear which has hung over the world for fifty years.” The CTBT was opened for signature by the Depositary of the Treaty, United Nations Secretary-General Boutros Boutros-Ghali, on 24 September 1996 in New York. Within 24 hours, 71 states had signed the Treaty, including all five Nuclear Weapons States.

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With over 2,000 nuclear tests conducted between 1945 and 1991, nuclear testing was a key element of superpower rivalry during the Cold War. This testing fed the nuclear arms race between the United States and the Soviet Union, where each vied for destructive supremacy in the event of a nuclear war. At the height of the nuclear arms race in 1986, global nuclear weapon stockpiles totalled almost 70,000 warheads.

The CTBT makes it very difficult for countries to develop nuclear weapons for the first time or, for countries that already have them, to make more powerful bombs. Today, worldwide nuclear forces of almost 16,000 warheads still sit in nuclear weapon stockpiles and with these may follow the temptation to conduct nuclear tests. As such, an in force CTBT is necessary for international security and to tackle the nuclear threat of today.

The need for progress in non-proliferation and nuclear disarmament is as important as ever. Virtually all countries apply the de facto moratorium on nuclear tests but, despite this, eight nuclear tests have been conducted since the CTBT opened for signature, four in 1998, and four this century. Even though only one country has tested nuclear weapons this century, one is one too many.

This year, on 6 January 2016, 77 CTBTO seismic monitoring stations picked up an unusual seismic event, with a recorded Richter scale magnitude of 4.85, emanating from the Democratic People’s Republic of Korea (DPRK). Announced as a nuclear test by the DPRK, this event met with a unanimous global expression of concern, and was subsequently strongly condemned by the United Nations Security Council as a clear threat to international peace and security.

During the CTBTO Symposium, Science & Diplomacy for Peace & Security, held in Vienna 25 January – 4 February 2016, Ambassador Cristian Istrate, Permanent Representative of Romania and Chairperson of the Preparatory Commission for the CTBTO, highlighted the international community’s united resolve against renewed nuclear testing as demonstrated in the unanimous condemnation of the DPRK’s announced nuclear test. “The whole international community widely shares the common recognition that nuclear tests should be prohibited. I also call on all nations to do everything they can to bring the CTBT into force”, he remarked.

Twenty years after the opening for signature of the CTBT, it is time to turn de facto into de jure.
The Role of the Treaty in International Peace and Security

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Twenty years after the opening for signature of the CTBT, it is time to turn de facto into de jure.
During the Treaty negotiations, the entry into force provision proved to be a politically challenging task. As the final formula, the decision was made that the Treaty must be signed and ratified by 44 States — known as Annex 2 States — that possessed nuclear power or research reactors. This clause has become the final hurdle that the CTBT needs to overcome. There remain eight Annex 2 States (China, the Democratic People’s Republic of Korea, Egypt, India, Iran, Israel, Pakistan, and the United States) that must ratify the Treaty before the nuclear test ban can become global law.

The CTBT contains a special mechanism to promote its entry into force — a conference designed to facilitate this objective takes place biennially. While its official designation is the Conference on Facilitating Entry into Force of the CTBT, it is more commonly known as the Article XIV conference in accordance with the relevant Treaty article. The ninth Article XIV conference took place at the United Nations, New York, in 2015, and was presided over by Erlan Idrissov, Minister of Foreign Affairs of Kazakhstan, and Fumio Kishida, Minister of Foreign Affairs of Japan.

One hundred eighty-three States so far have signed the Treaty, and 164 have ratified it, out of a total of 196 States. As of May 2016, the most recent States to sign and ratify are Nauru and Angola respectively. “The long-term effects from nuclear testing, such as the Castle Bravo H-bomb test in the Marshall Islands 60 years ago, continue to haunt the lives of our fellow islanders. All forms of nuclear testing need to be outlawed to protect future generations in the Pacific and elsewhere,” said Prime Minister of Niue, Toke Tufukia Talagi, upon signing. Unfortunately, with the continued absence of the eight Annex 2 countries’ ratifications, the Treaty awaits its entry into force.
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International Support for the Treaty

»After more than five decades of talks, it is time for the testing of nuclear weapons to finally be banned.«

BARACK OBAMA
44th President of the United States (2009)

»This treaty was a great victory for international diplomacy at the time and showed just how effective such diplomacy can be at resolving the greatest challenges to global security.«

VLADIMIR PUTIN
President of the Russian Federation (2016)
By mobilizing communities worldwide to lobby for the entry into force of the Treaty, civil society directly engages and supports the goals of the CTBT.

Since 1945, many organizations have actively protested against nuclear weapons use, development, and testing. Civil society has sought to establish direct contact with legislative representatives and influence government policy while keeping the public informed on issues of non-proliferation and disarmament. These peace groups have organized grassroots campaigns to increase public awareness on the dangers of nuclear weapons and worked to ensure that the CTBT has not fallen off the public agenda.

The CTBTO works with civil society. For this reason the organization initiated and continues to promote the Group of Eminent Persons (GEM) and the CTBTO Youth Group.

The GEM comprises of internationally recognized experts in nuclear non-proliferation and disarmament, and was launched in September 2013 at United Nations Headquarters in New York. Through their expertise, experience, and political standing, GEM members support and complement efforts to promote the Treaty’s entry into force as well as reinvigorating international endeavours to achieve this goal. Current members include Nobuyasu Abe, Hans Blix, Des Browne, Jayantha Dhanapala, Cristian Diaconescu, Sérgio de Queiroz Duarte, Michel Duclos, Wolfgang Hoffmann, John Hutton, Igor Ivanov, Angela Kane, Dina Kawar, Susan le Jeune d’Allegeershebe, Johannes Kytle, Hu-Jin Lee, Susana Malcorra, Janos Martonyi, Federica Mogherini, Sipho George Nene, William Perry, Kevin Rudd, Ellen Tauscher, and Sha Zukang.

The CTBTO Youth Group, on the other hand, was launched in Vienna, Austria, in January 2016. The group is composed of students and young graduates interested in contributing to global peace and security, and who are actively engaged in promoting the CTBT and its verification regime.

Civil society support for the Treaty remains vital, as Rebecca Johnson, Director of the Acronym Institute for Disarmament Diplomacy, points out, “As we saw in the final, successful push for the CTBT, partnerships between governments and civil society are necessary.”

»I admire you for what you have accomplished and I implore you: don’t lose heart, don’t relax, and don’t allow the politicians and diplomats to get away with letting the de facto moratorium stand. We all have an obligation to work for ratification – and entry into force. For the victims of Hiroshima, Nagasaki, and the legacy of 2,000 nuclear tests. For the safety and security of our individual countries. For the future of the planet.«

DESBROWNE
Vice Chairman, Nuclear Threat Initiative, and member of the CTBTO Group of Eminent Persons (2015)
People Power – Civil Society Support for the Treaty

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Des Browne
Vice-Chairman, Nuclear Threat Initiative, and member of the CTBTO Group of Eminent Persons (2015)
As an essential part of the CTBT’s unique verification regime, the International Monitoring System (IMS) currently consists of well over 300 facilities located in diverse environments around the globe. The IMS utilizes the most modern technology available to apply four complementary verification methods: seismic, hydroacoustic, and infrasound stations monitor the earth, oceans, and the atmosphere, while radionuclide stations detect releases of radioactive particles and noble gases into the environment. The data that the monitoring systems collect are then transmitted to the International Data Centre (IDC) in Vienna where they are processed to produce products that are shared, along with the raw data, with CTBTO Member States.

In August 1997, the first IMS team met to size up the pioneering task of constructing the IMS, and assess the associated challenges. The IMS had to be built and become fully operational within a brief timeframe to ensure that the Treaty could be enforced. This tight schedule meant that many innovations were developed and incorporated into commercially available equipment, all while adhering to the CTBT’s stringent specifications. Today, the IMS is nearing completion with around 90% of its facilities established.

Time and time again, the IMS has proved its worth. The IMS detected all four announced nuclear tests of the Democratic People’s Republic of Korea (DPRK), and accurately located them at the DPRK test site. Thanks to the IDC’s automatic data analysis, Member States rapidly receive preliminary information on suspicious events. “The system as it is today has shown its effectiveness. Today (January 2016) we had the DPRK test where the seismic component of IMS lit up like a Christmas tree”, remarked David Jepsen, Coordinator of the IMS Division at the CTBTO.

Station operators across the globe are responsible for the day-to-day operation and maintenance of monitoring stations all over the planet. Through continuous human capacity building and training of operators, the IMS has been able to adhere to specifications while providing high levels of data availability. Several thousand experts from most of the organization’s 183 Member States regularly work together to maintain and improve the capabilities of the IMS, and ensure that the CTBT has a robust verification regime upon entering into force. “I want the IMS to continue benefiting from cutting edge scientific developments in all CTBT verification technologies; in this regard, I will engage vigorously with my team and with the scientific community”, said Nurcan Meral Özel, Director of the IMS Division, CTBTO.

»The CTBT verification regime is one of the great accomplishments of the modern world. The international monitoring system is nearly complete; it is robust, it is effective, and it has contributed critical scientific data on everything from tsunami warnings to tracking radioactivity and nuclear reactor accidents.«

JOHN KERRY
68th United States Secretary of State (2014)
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With Wolfgang Hoffmann as its Executive Secretary and just a handful of staff, the CTBTO started its operations on the seventh floor of the Vienna International Centre on 17 March 1997.

Even though the Treaty negotiations had been long and complex, the period between the Treaty’s opening for signature on 24 September 1996, the first meeting of the CTBTO on 19 November 1996, and the date the organization started its operations comprised of only six months.

Two weeks after India conducted two sets of nuclear tests, Pakistan responded by exploding two sets of its own underground nuclear devices on 28 May 1998. The tests sparked international condemnation and resulted in the universal adoption of United Nations Security Council Resolution 1172 demanding that both countries refrain from further tests and accede to the CTBT.

Although the CTBTO was still in its infancy, the organization was already receiving data from its initial seismic stations. It was therefore able to provide Member States with estimates of the time and location of the events.

On 13 October 1999, the U.S. Senate voted 51-48 against the Treaty, well short of a required two-thirds majority for Treaty ratification. The Senate’s failure to ratify the CTBT marked the first time that a national legislature had rejected the CTBT. Speaking on CNN after the Senate failed to ratify the CTBT, U.S. Secretary of State Madeleine Albright noted, “What we’ve lost for the time being is the real international leadership in terms of trying to make others live up to the CTBT.”

On 18 December 2000, the first IMS hydro acoustic station was certified. HA08 is located on the island of Diego Garcia in the British Indian Ocean Territory, Chagos Archipelago. IMS hydroacoustic stations monitor the oceans for evidence of a nuclear explosion. Installation of the stations is a highly specialized and costly operation, involving numerous technical and logistical challenges.

Now nearly complete, the network comprises of 11 stations. Comparatively few hydroacoustic stations are required because of the efficient transmission of sound through water, meaning that even small signals are readily detectable at very long distances.

The depositary of the CTBT, United Nations Secretary-General Boutros Boutros-Ghali, formally opened the Treaty for signature on 24 September 1996. Following the United States, the other four Nuclear Weapon States (China, France, the Russian Federation, and the United Kingdom) all signed the Treaty that day in New York.

By the end of the day, another 66 States had signed the Treaty and taken the first steps towards making the commitment never to conduct nuclear tests of any kind anywhere on Earth.

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On 31 October 2001, the world’s first radionuclide laboratory designed to verify compliance with the CTBT was brought into service. RL03 is located just outside Vienna, Austria.

Radionuclide stations detect radionuclide particles and noble gases like xenon which can help provide evidence of a nuclear explosion. Radionuclide laboratories provide support for the analysis of information collected by radionuclide stations. Today, the network includes 16 laboratories worldwide.
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The CTBTO begins work in Vienna

Nuclear tests by India and Pakistan

U.S. Senate fails to give consent to CTBT ratification

First hydro-acoustic station certified

First radionuclide laboratory certified

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Mauritania’s ratification on 30 April 2003 increased the number of ratifications to 100. The photo shows radionuclide station RN43 in the distance during a sand storm at Nouakchott, Mauritania. A number of other countries signed or ratified the CTBT in 2003: Afghanistan, Albania, Algeria, Côte d’Ivoire, Cyprus, Eritrea, Gambia, Honduras, Kuwait, Kyrgyzstan, Oman, and Palau.

When infrasound station IS36 on New Zealand’s Chatham Island was certified on 24 November 2004, it became the 100th IMS station to become fully operational. When complete, a network of 60 infrasound stations will monitor the Earth for atmospheric nuclear explosions.

The construction of infrasound stations around the globe since 1997 has contributed to a revival of scientific interest in this technology. After the massive tsunami caused by an earthquake off the coast of Sumatra, Indonesia, on 26 December 2004 claimed the lives of over 230,000 people, CTBTO Member States gave approval in 2005 for the use of CTBT verification data for disaster mitigation purposes.

On 9 October 2006, the Democratic People’s Republic of Korea (DPRK) announced that it had conducted a nuclear test. Over 20 IMS stations detected the event. Less than two hours later, Member States received information on the time, location, and magnitude of the event. Two weeks later, IMS radionuclide station RN16 in Yellowknife, Canada, registered a high concentration of the radionuclide xenon-133. Using Atmospheric Transport Modelling calculations, scientists at the CTBTO could link the detection of xenon-133 at RN16 to the site of the explosion in DPRK, providing “smoking gun” evidence of a nuclear test. The DPRK is the only State to carry out nuclear tests this century. In addition to 2006, announced tests took place in 2009, 2013, and 2016.

**Primary seismic station PS19 in Freyung, Germany, was one of 11 seismic stations to be certified in 2002. The yellow markings in the picture indicate the array element configuration. Seismic stations monitor the Earth for underground nuclear explosions. Primary seismic stations relay data continuously in real time to the International Data Centre in Vienna. Auxiliary seismic stations provide information only upon request.**

When complete, the seismic network will comprise 50 primary stations and 120 auxiliary stations around the globe.

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Around 450 scientists from over 70 countries congregated at the Hofburg Palace in Vienna to assess the CTBT’s capability and readiness to detect nuclear explosions anywhere on the planet. Participants at the International Scientific Studies conference also discussed how the CTBT’s global alarm system could benefit from future scientific and technological developments.

“I have called on numerous occasions for those States whose ratification is required for the Treaty’s entry into force to act first without waiting for others to do so … be courageous. Take the initiative. Be the first movers”, said UN Secretary-General Ban Ki-moon, at UN Headquarters, New York, in September 2010. Earlier in the year, the Nuclear Non-Proliferation Treaty Review Conference agreed a final document that reaffirmed “the vital importance of the entry into force of the Comprehensive Nuclear-Test-Ban Treaty as a core element of the international nuclear disarmament and non-proliferation regime”. It also listed five action points including the aim of the entry into force of the Treaty.

By the end of 2010, 182 countries had signed the CTBT and 153 had ratified.

After the 11 March 2011 devastating tsunami caused serious damage to the Fukushima Daiichi nuclear power plant in Japan, the CTBTO provided 120 Member States and 1,200 institutions, as well as international organizations concerned with disaster mitigation, with information about the composition and dispersal of radioactive materials stemming from the plant.

The CTBTO also became a reliable source of information to the media and the general public worldwide on the radioactive dispersal.

On 6 February 2012, Indonesian Foreign Minister Marty Natalegawa deposited his country’s instrument of ratification of the CTBT with UN Secretary-General Ban Ki-moon at UN Headquarters in New York. As one of the 44 Annex 2 countries that must ratify the CTBT before it can enter into force, Indonesia’s ratification was very significant. “I am determined to ensure that Indonesia’s decision today will create momentum to encourage others who are still holding out to do the right thing. And the only right thing is to ratify the CTBT now, no more procrastination, no more delaying because it is right, it is proper, and it makes a more secure world”, said Natalegawa.

Over a four week period, the CTBTO simulated its first on-site inspection (OSI), allowing the organization to assess the readiness of the OSI regime. The inspection area was located in a remote corner of Semipalatinsk – the Soviet Union’s nuclear test site – ensuring that equipment was tested under realistic conditions. Around 200 participants were involved and over 50 tonnes of equipment were shipped to the site.

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From 3 November to 9 December 2014, Integrated Field Exercise 2014 (IFE14) simulated a CTBTO on-site inspection in the Hashemite Kingdom of Jordan. The inspection team conducted a meticulous search to establish whether or not a nuclear explosion had occurred. The exercise was in response to a technically realistic but fictional scenario. IFE14 involved four years of preparation, 150 tonnes of specialized equipment, and over 200 international experts. During the five-week exercise, the inspection team searched an inspection area of nearly 1,000 square kilometres using 15 of the 17 techniques permissible under the CTBT.

“We’ve now mastered all components of the verification regime, and brought our on-site inspection capabilities to the same high level as the other two components, the 90% complete network of monitoring stations and the International Data Centre”, said CTBTO Executive Secretary, Lassina Zerbo.

On 27 April 2016, at a CTBTO panel discussion, UN Secretary-General Ban Ki-moon stated, “the eight countries that must ratify for entry into force have a special responsibility. They can advance us on the road to a nuclear weapon-free world. All countries can add to the pressure by ratifying. This strengthens the norm of universality. And it shows the world is united against nuclear tests.” Furthermore, he welcomed the voluntary moratoria against nuclear testing, but noted that this would never substitute for a legally binding CTBT.

The High-Level Ministerial Meeting in June 2016 looks to sustain and generate further political momentum, as well as public attention, for the entry into force of the Treaty.
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"Through this exercise, we have shown the world that it is absolutely hopeless to try to hide a nuclear explosion from us. We've now mastered all components of the verification regime, and brought our on-site inspection capabilities to the same high level as the other two components, the 90% complete network of monitoring stations and the International Data Centre", said CTBTO Executive Secretary, Lassina Zerbo.

On 15 February 2013, at 03:22 GMT, 20 of the CTBTO’s infrasound stations detected signals from a meteor that entered the atmosphere and disintegrated in the skies over Chelyabinsk, Russia. The sub-audible sound was detected by the IMS from as far as 15,000 km away in Antarctica. The data recorded helped scientists to locate the meteor, measure energy release, its altitude, and size. Margaret Campbell-Brown, an Associate Professor in the Department of Physics and Astronomy at the University of Western Ontario, Canada, commented, “Statistically, something this size hits the Earth approximately once every 50 years, though nothing this size or larger has been observed to hit the Earth since 1908. This event was nearly ten times as energetic as the Sulawesi, Indonesia, fireball of 2009”.

The CTBTO Science and Technology 2015 Conference (SnT2015) took place from 22 to 26 June 2015 at the Hofburg Palace in Vienna, Austria. It was the largest in a series of multidisciplinary conferences designed to further enhance the strong relationship between the scientific and technological community and the CTBTO. The conference series provides a forum for scientists from around the world to exchange knowledge and share advances in the monitoring and verification technologies of relevance to the CTBT. Such interaction helps ensure that the Treaty’s global verification regime remains at the forefront of scientific and technical innovation.

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The symposium “Science and Diplomacy for Peace and Security: the CTBT@20” was the first in a series of events to mark the 20th anniversary of the opening for signature of the CTBT. From 25 January until 4 February 2016, eminent personalities, internationally recognized experts, and thought leaders led stimulating discussions with members of civil society and academia. At this event, the CTBTO Youth Group was formed in order to inject new and creative ideas into the debate on global peace and security.
Data form the basis for the CTBT’s verification regime. Once collected and analysed at the CTBTO’s International Data Centre (IDC), the CTBTO Member States are provided with the basic information needed to determine whether a suspicious event has occurred and whether this event may have been a nuclear explosion.

As a central element of the CTBT verification mechanism, the IDC was established in Vienna in 1999. Prior to that, the Prototype International Data Centre processed seismic and hydroacoustic monitoring data, and in 1997 the first bulletins were sent to Member States.

Today, several gigabytes of data are received on a daily basis. The information is processed, analysed, and archived, providing answers to the most pressing questions concerning event detection.

Despite the sophistication of the automatic data processing, results always have to be reviewed by analysts, making sure that only events meeting certain criteria are considered and included in the Reviewed Event Bulletins. This report is presented to the CTBTO Member States, giving a clearer picture of what has occurred, and enabling them to take decisions with regards to the nature of events.

“The Member States are ‘hungry’ for data and IDC products. I think we move between 10-14 gigabytes of data information a day”, says Gerhard Graham, Programme and Project Coordinator at the IDC. “Last year, we had close to half a million requests for information in raw data and products of the IDC.”

New ways of using these data are being discovered continuously. This not only applies to detecting nuclear tests, but also for civil and scientific uses. The Science and Technology (SnT) conferences, organized by the CTBTO biennially, look to enhance the strong relationship between the scientific and technological community and the CTBTO. The SnT 2015 brought together nearly 1,100 registered participants, and over 550 abstracts illuminating the ways in which data from the IDC are being used at the forefront of scientific and technical innovation. Randy Bell, Director of the IDC Division, CTBTO, noted, “The SnT Conferences are a component of our continuous improvement process. They help us identify emerging technology and methods that can be applied to improve test monitoring”. During the conference, participants discussed the latest scientific and technological developments to further enhance verification of the CTBT, and spin-off benefits of CTBTO data for disaster warning and science.

The credibility of CTBT verification capabilities must be safeguarded for the future. This requires a permanent and fruitful exchange with the scientific community to allow the CTBTO to remain at the forefront of those sciences and technologies of relevance for verification.«

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Meeting the Data Demand - The International Data Centre

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Hunting Down a Fresh Nuclear Explosion – The CTBTO's On-Site Inspections

A CTBTO on-site inspection (OSI) is considered the final verification measure in establishing whether or not a violation of the CTBT – a nuclear explosion – has taken place. As stipulated by the Treaty, once requested by a Member State and approved by the Treaty’s Executive Council, the CTBTO has to rapidly move equipment and an expert team of inspectors to a suspicious location, and report back progress. An OSI is a challenging, but vital, part of the CTBT’s verification regime.

“The sole purpose of an on-site-inspection is to clarify, or find facts, on the ground whether a nuclear explosion or a breach of obligation of the Treaty has been conducted”, highlights Director of the On-Site Inspection Division at the CTBTO, Oleg Rozhkov. “As such, CTBT on-site inspections are a viable deterrent against would-be Treaty violators.”

A CTBTO OSI inspection team uses a variety of techniques to determine whether or not a violation has occurred, including ground-penetrating radar, multi-spectral imaging, radiation monitoring, seismological monitoring, magnetic field mapping, and probing for cavities in the earth. By combining these and other methods of data collection, inspectors gain a comprehensive picture to evaluate whether a nuclear test has been conducted or not.

The Integrated Field Exercise (IFE) which took place in Kazakhstan in 2008 (IFE08), at the former Soviet nuclear test site of Semipalatinsk, was the CTBTO’s first opportunity to practice all of the elements of an inspection together as one integrated process.

The most recent Integrated Field Exercise, which took place in Jordan in 2014 (IFE14), allowed the CTBTO to take the capabilities developed at IFE08 to a new, technically more advanced, level. “IFE14 served as the true litmus test for showing that significant progress had been made in developing OSI capabilities... It also clearly demonstrated that we have the core capabilities necessary to conduct and achieve the primary objective of an on-site inspection, as provided for by the CTBT”, added Rozhkov.
Hunting Down a Fresh Nuclear Explosion – The CTBTO’s On-Site Inspections

A CTBTO on-site inspection (OSI) is considered the final verification measure in establishing whether or not a violation of the CTBT – a nuclear explosion – has taken place. As stipulated by the Treaty, once requested by a Member State and approved by the Treaty’s Executive Council, the CTBTO has to rapidly move equipment and an expert team of inspectors to a suspicious location, and report back progress. An OSI is a challenging, but vital, part of the CTBT’s verification regime.

“The sole purpose of an on-site-inspection is to clarify, or find facts, on the ground whether a nuclear explosion or a breach of obligation of the Treaty has been conducted”, highlights Director of the On-Site Inspection Division at the CTBTO, Oleg Rozhkov. “As such, CTBT on-site inspections are a viable deterrent against would-be Treaty violators.”

Inspection techniques include, among others, overflights; multi-spectral imaging; radiation monitoring; seismological monitoring; magnetic field mapping; ground penetrating radar; and, the final technique, drilling to search for explosion cavities in the earth. By combining these and other methods of data collection, inspectors gain a comprehensive picture to evaluate whether a nuclear test has been conducted or not.

OSIs will only occur once the CTBT has entered into force. However, two large OSI simulation exercises have been conducted demonstrating their effectiveness.

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IFE14 proves that would-be violators of the CTBT cannot hope to evade detection.”

LASSINA ZERBO
CTBTO Executive Secretary (2014)
Helping to Mitigate Disasters

The early 21st century witnessed a series of devastating, and unpredictable, natural disasters. The December 2004 Indian Ocean earthquake and tsunami, the January 2010 earthquake in Haiti, and the March 2011 earthquake and tsunami in Japan were examples of the devastating force of nature. These events, fearsome in their scope, also reminded us of our limitations in understanding how our natural environment works.

When the CTBTO’s International Monitoring System (IMS) was planned, it had one purpose in mind – monitoring for nuclear tests. However, after the Indian Ocean earthquake of 2004, scientists realized that the IMS had detected and gathered data from the event.

Scientists discovered that the IMS’s four complementary methods of gathering data (seismic, hydroacoustic, infrasound, and radionuclide) not only detect nuclear tests, but also allow for an unprecedented level of environmental surveillance. The CTBTO’s IMS is therefore able to detect volcanoes, earthquakes, and provide advance warning of tsunamis. By utilizing the data gathered by the IMS, scientists around the world have been able to devise new studies to analyse natural disasters.

The CTBTO’s IDC shares information in real-time with tsunami warning centres in 14 countries to help them issue more timely and precise warnings. The CTBTO has also established strong collaborations with international organizations, such as the Intergovernmental Oceanographic Commission (IOC), the International Atomic Energy Agency (IAEA), the International Civil Aviation Organization (ICAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Office for Disaster Risk Reduction (UNISDR), and the World Meteorological Organization (WMO). As Patricio A. Bernal, former Executive Secretary of the IOC and Assistant Director-General of UNESCO commented, “There is no question that the access to IMS data for tsunami warning systems is a major contribution by the CTBTO Member States, which may reduce the loss of lives and property due to natural disasters, a common goal of all the nations of the world”.

On 11 March 2011, an earthquake under the Pacific Ocean triggered a 10-metre high tsunami that devastated the north-eastern seaboard of Japan. When the tsunami struck the Fukushima Daiichi nuclear power station, cooling systems failed for three of the reactors. It was the worst nuclear accident since the Chernobyl accident of 1986, and given the most severe classification on the International Nuclear Event Scale.

Within 24 hours of the accident, more than 35 IMS radionuclide stations were providing information on the spread of radioactive particles and noble gases. The Takanai station, RN38, located around 260 km from Fukushima, was the first to pick up radionuclides such as iodine-131 and cesium-137. The radioactive cloud was tracked as travelling first to Russia and then the United States, before dispersing across the northern hemisphere and around the entire globe. After a month, radioactivity had spread to the southern hemisphere of the Asia-Pacific region, and had been detected at stations located in Australia, Fiji, Malaysia, and Papua New Guinea.

With Fukushima, the IMS demonstrated its ability to track radiation and predict dispersion using Atmospheric Transport Modelling. This enabled CTBTO Member States to provide valuable information to their publics and implement disaster mitigation plans accordingly. “The importance of inter-organizational and inter-sectoral collaboration is one of the most critical lessons learned from the Fukushima disaster”, remarked Maria Neira, Director of the Department of Health and Environment at the WHO, speaking on the first anniversary of the disaster. “CTBTO data proved crucial in enabling the WHO to provide accurate information to the public on health issues after the nuclear accident.”

BAN Ki-moon
United Nations Secretary-General (2011)

TOSHIRO OZAWA
Permanent Representative of Japan to the UN in Vienna (2012)

MICHEL JARRAUD
Former Secretary-General of the World Meteorological Organization (2011)

»I look forward to further collaboration with the CTBTO, in this and other key areas, in particular for the protection of life, livelihoods and property: health and well-being; safety on land, at sea and in the air; sustainable economic growth; the protection of natural resources and environmental quality; and especially for natural disaster risk reduction activities and climate change adaptation.«

»Japan appreciates the contribution of the CTBTO and sincerely thanks its staff for their dedicated work during those difficult times.«

»Even before entering into force, the CTBT is saving lives.«
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Experts examine the Fukushima Daiichi nuclear power plant following the accident. © 2011 WMO / IAEA

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Former Secretary-General of the World Meteorological Organization (2011)
At its foundation in 1997, the CTBTO’s expectations about the IMS focused on an accurate and impartial way to detect nuclear tests. Today, the IMS includes over 300 monitoring stations, distributed around the globe. The four complementary methods used to gather data (seismic, hydroacoustic, infrasound, and radionuclide) constantly verify compliance with the CTBT.

In addition, the cutting-edge technology of the IMS, combined with the geographical distribution of the monitoring stations, led scientists to discover unexpected benefits beyond supporting nuclear non-proliferation. For example, hydroacoustic monitoring stations have allowed scientists to study whale migration. “IMS hydroacoustic stations record whale sounds around the world … They therefore represent a unique data set for obtaining critical information on large whales”, according to Flore Samaran, researcher at the Centre d’Études Biologiques de Chizé in France.

In February 2013, infrasonic waves were detected as the “Chelyabinsk meteor” broke up over the Urals.

The fireball was picked up by 20 infrasound stations in the CTBTO network and the information collected has proved essential in aiding scientific understanding of the meteorite phenomena. “We saw straight away that the event would be huge. The observations are some of the largest that CTBTO’s infrasound stations have ever detected”, noted Pierrick Mialle, CTBTO Acoustic Scientist.

The CTBTO shares and pools its valuable data with scientists and organizations from many CTBTO Member States who find benefits in their own scientific analysis of the data. Civil and scientific benefits of these formal partnerships have been found in, among others, monitoring climate change and improving our understanding of the tectonics of the planet. Through such collaborations, IMS data will make a strong contribution to future nationally and internationally conducted environmental studies, whether in geological, marine, or spatial research fields. Furthermore, this research has the potential to aid the United Nations 2030 Agenda for Sustainable Development and contribute to several of its goals.

» The climate system, as part of a broader earth system, is complex and there are many areas where it is imperative for fundamental understanding to be substantially improved. Enhancing our ability to mitigate and adapt to climate change is an excellent example where international scientific partnership was a critical prerequisite. The same will apply to non-proliferation. «

Naledi Pandor
Minister of Science and Technology of South Africa (2015)
CTBTO and the Environment

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CTBT20 | 2016

TOP LEFT: Attendees of the Infrasound Technology Workshop examining the civil and scientific benefits of infrasound technology, 2014, Vienna.

TOP RIGHT: Island view of Juan Fernandez Island, Chile, home of hydroacoustic station HA02.

MIDDLE: The smoke trail from the Chelyabinsk meteor, 2013. © NY TIMES

BOTTOM LEFT: Naledi Pandor, Minister of Science and Technology of South Africa, opening of the CTBTO SnT 2015, Vienna.

BOTTOM RIGHT: The smoke trail from the Chelyabinsk meteor, 2013. © NIKITA PLEKHANOV

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This year, 2016, is an an is an opportunity to reflect upon the CTBT, on the achievements made so far and the challenges that lie ahead. Accordingly, the Symposium “Science and Diplomacy for Peace and Security: the CTBT@20”, held at the beginning of the year in Vienna, sought to promote dialogue and cooperation between Member States, civil society, and academia. As the first in a series of events marking the 20th anniversary, 2016 marks a strong push towards bringing the CTBT into force.

During the Symposium, Executive Secretary Lassina Zerbo highlighted the importance of including youth in discussions on global peace and security to inject new and creative ideas into the debate. “I believe that the time has come to bring youth more firmly on board”, said Zerbo. “I wish to invite all students and young graduates who are directing their careers to contribute to global peace and security to join a new CTBTO Youth Group.”

In his concluding speech during the Symposium, Des Browne, former UK Secretary of State for Defence and member of the CTBTO Group of Eminent Persons (GEM), suggested a new approach in realizing the goal of entry into force of the CTBT. “Rather than repeating our message in over-stronger and louder voices, perhaps it would be effective to spend more time listening to what the reluctant States have to say”, remarked Browne.

In April, United Nations Secretary-General Ban Ki-moon addressed an audience, ranging from veteran officials to young leaders, on the need for the entry into force of the CTBT.

This 20th anniversary of the Comprehensive Nuclear-Test-Ban Treaty is not a celebration but a reminder of the work remaining”, Ban Ki-moon told the audience. “It is a call to action.”

Furthermore, this June, participants of the High Level Ministerial Meeting on the CTBT are invited to voice their needs, their security concerns, and their demands with a view to reinvigorating discussions on the issues currently blocking progress.

“The CTBT’s entry into force is the next goal in nuclear non-proliferation. The historical achievement of the Joint Comprehensive Plan of Action between Iran and the P5+1 demonstrated that through diplomacy consensus can be reached. Our goal is to find consensus for the CTBT. “It has to be raised to a higher political level”, said Angela Kane, former UN High Representative for Disarmament and GEM Member, during the Symposium. “We need to say that this is something that needs to come into force and to put it back on the agenda again.”

Federica Mogherini, High Representative of the European Union for Foreign Affairs and Security Policy, during the CTBT Symposium, 2016.

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Permanent Representative of Romania and Chair of the CTBTO Preparatory Commission (2016)
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»No matter how much our views differ in terms of CTBT or nuclear related issues, I think that this time we should be more united than ever to work for the entry into force of the Treaty. I would regard this as a main task for the Prep Com for this year, 2016.«

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Permanent Representative of Romania and Chair of the CTBTO Preparatory Commission (2016)

FEDERICA MOGHERINI
High Representative of the European Union for Foreign Affairs and Security Policy (2015)
The Comprehensive Nuclear-Test-Ban Treaty Organization

EXECUTIVE SECRETARIES

1997–2005
Wolfgang Hoffmann
Germany

2005–2013
Tibor Tóth
Hungary

2013–PRESENT
Lassina Zerbo
Burkina Faso

CTBT20 | 2016
The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans all nuclear explosions.

It opened for signature on 24 September 1996 in New York.

As of mid-2016, 183 States have signed the Treaty and 164 have ratified it. Of the 44 nuclear capable States which must ratify the CTBT for it to enter into force, the so-called Annex 2 countries, 36 have done so while eight have yet to ratify: China, the Democratic People’s Republic of Korea, Egypt, India, Iran, Israel, Pakistan, and the United States.

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) consists of the States Signatories and the Provisional Technical Secretariat. The main tasks of the CTBTO are to promote signatures and ratifications and to establish a global verification regime capable of detecting nuclear explosions underground, underwater, and in the atmosphere.

The regime must be operational when the Treaty enters into force. It will consist of 337 monitoring facilities supported by an International Data Centre and on-site inspection measures. As of mid-2016, roughly 90 percent of the facilities of the International Monitoring System (IMS) are established.