CTBTO
PREPARATORY COMMISSION
preparatory commission for the comprehensive nuclear-test-ban treaty organization

CTBTO Spectrum

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Cover designed by Todd Vincent

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Who we are

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans all nuclear explosions on Earth. It opened for signature on 24 September 1996 in New York.

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 consists of 337 monitoring facilities supported by an International Data Centre and on-site inspection measures.

Editorial

In March 1963, President John F. Kennedy said: "I am haunted by the feeling that by 1970, unless we are successful, there may be 10 nuclear powers instead of 4, and by 1975, 15 or 20." Fortunately, Kennedy's timetable was averted. However, there has been a sense over recent years that his prediction could come true, several decades later.

In today's world, the ban on nuclear testing is more important than ever.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) prevents the spread of nuclear weapons to additional States and restricts the development of advanced, new types of nuclear warheads. It acts as a catalyst for progress on nuclear disarmament, aiding measures such as de-alerting and strategic and non-strategic arms reductions.

Climate change and the energy crisis are two priorities on the global agenda. Closely related is the resurgence of nuclear energy as nations strive to meet their growing energy demands while minimizing their potential impact on the environment. This results in an increase in the production of fissile material as the number of countries and facilities managing the nuclear fuel cycle also grows. In such a world, it is essential that the line between prohibited and permitted nuclear activities is drawn clearly and irrevocably. The CTBT provides the last and most visible barrier against nuclear weapons development. A CTBT in force would also be an incentive for ending the production of fissile material for weapons use, pending the negotiation and entry into force of a Fissile Material Cut-Off Treaty, as well as reducing stocks of such materials.

When Kennedy made his speech, great leadership combined with multilateral arms control initiatives, such as the Partial Test Ban Treaty in 1963 and the Non-Proliferation Treaty (NPT) in 1968, succeeded in limiting the spread of nuclear weapons. Today we need the same strong leadership, with the United States at the forefront in international non-proliferation and disarmament efforts.

The political momentum for the Treaty continues to grow. Colombia, Malaysia and Iraq are key countries that recently signed or ratified the Treaty. Strong support for the Treaty has also been expressed at the highest political levels by President Nicolas Sarkozy of France, Prime Minister Gordon Brown of the United Kingdom and numerous foreign ministers. Former U.S. foreign affairs and defense policy leaders – George Shultz, William Perry, Henry Kissinger and Sam Nunn, supported by more than 40 others – have called for the CTBT's entry into force from a bipartisan platform. The U.S. Democratic Party nominee, Barack Obama, has made his support for CTBT ratification clear on several occasions and U.S. Republican Party nominee, John McCain, has pledged to have another look at the Treaty.

The CTBT's global alarm system is also constantly expanding. 256 monitoring facilities have been installed to date. The number of these facilities transmitting data to Vienna from around the world has tripled since 2004 and the volume of data made available to users has doubled. Over 100 countries and over 1000 individual users now access data bulletins and analyzed products. A brand new Global Communications Infrastructure has been put in place, completing a ten year programme worth tens of millions of dollars. The first ever on-site inspection field exercise (IFE08) is being conducted on an unprecedented scale at the former nuclear test site at Semipaltinsk in Kazakhstan: the exercise involves over 200 participants and over 50 tonnes of equipment deployed over 1000 square kilometres of terrain.

In view of the current political climate, this edition of CTBTO Spectrum focuses on the role of the CTBT in the wider non-proliferation and disarmament context. We are privileged to have received articles from several internationally acclaimed leaders. President Oscar Arias of Costa Rica gives his views on the steps necessary to ensure the Treaty's entry into force. The Director General of the IAEA, Dr. Mohamed ElBaradei, stresses the CTBT's key role in global security. Former U.S. Senator Sam Nunn expounds on the "race between cooperation and catastrophe." U.S. senior diplomats, Ambassador Max Kampelman and Ambassador Tom Graham, explore the threat that nuclear weapons pose to humanity, and the Executive Director of the Arms Control Association, Daryl Kimball, examines the reasons for the enduring value of the CTBT. This edition also includes highlights about the IFE08, the cooperation between the CTBTO and the World Meteorological Organization, the challenges of establishing monitoring stations in Antarctica, and the ongoing International Scientific Studies project to assess the readiness and capabilities of the CTBT's verification regime.

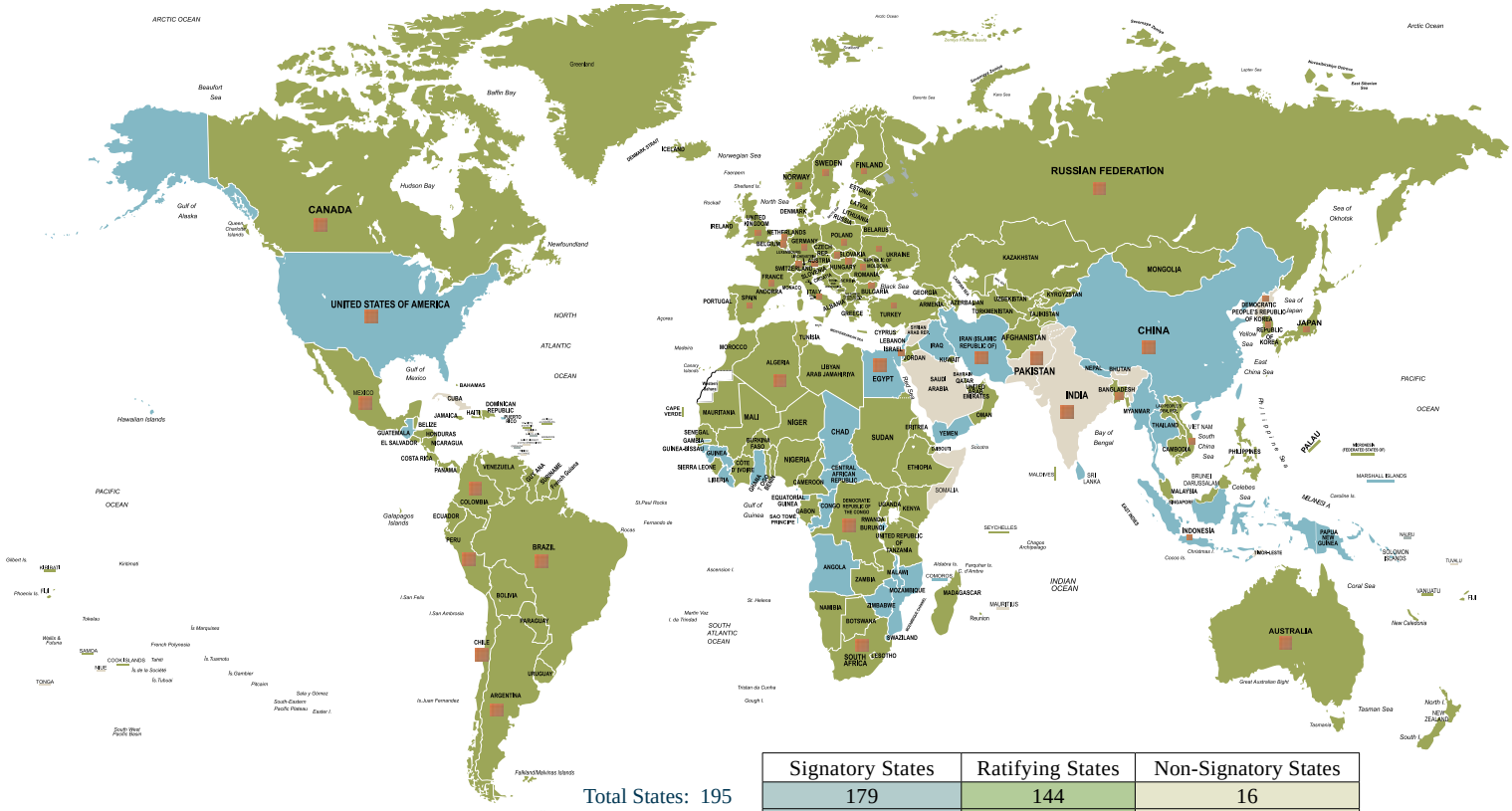
As was the case 45 years ago, the governments of today will need to visualize the larger picture and ask themselves what world they would like their children to live in. Would they want to go back to a "free-for-all" with the risk of a new nuclear arms race? Or would they prefer to continue building the global security architecture with multilateral treaty arrangements such as the CTBT at its core?

I deeply hope they will choose the latter.

Tibor Tóth
Executive Secretary
Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization

Treaty signatures and ratifications

CTBT signatures and ratifications as of 12 September 2008



Total States: 195

Annex 2 States: 44

Signatory States	Ratifying States	Non-Signatory States
179	144	16
41	35	3

In the spotlight

The Comprehensive Nuclear-Test-Ban Treaty (CTBT): The Way Forward

President Oscar Arias of Costa Rica presents his views on the CTBT

Q: *Since the Comprehensive Nuclear-Test-Ban Treaty (CTBT) opened for signature in 1996, Costa Rica has been unwavering in its political and technical support. It is coordinating the Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty (Article XIV Conference) until 2009. It also chaired the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in 2007 and the current Director of the International Monitoring System Division of the CTBTO is a Costa Rican national.*

In view of this background and of Costa Rica's commitment to global nuclear disarmament, what steps do you consider necessary over the next few years to ensure the Treaty's entry into force?

A: Costa Rica reiterated its strong support for the CTBT when it assumed, together with Austria, the co-chairmanship of the fifth Article XIV Conference held in Vienna from 17 to 18 September 2007.

The Conference's final declaration called for measures to promote the entry into force of the CTBT. Therefore, renewed efforts must be made to call on outstanding States to sign and ratify the Treaty.

While continuing to take advantage of bilateral occasions as well as multilateral fora for this purpose, I believe that new concerted efforts and strategies must be defined for the nine outstanding countries.

Let us review the list of States whose signature/ratification is still outstanding, and who need to ratify the Treaty for it to enter into force (Annex 2 countries): China, the Democratic People's Republic of Korea, Egypt, India, Indonesia, Iran, Israel, Pakistan, and the United States.

The probable exception here is Indonesia, which is likely to respond to intensified lobbying efforts from like-minded States and ratify in the near future.

In the case of India and Pakistan, it is important to work out a creative deal whereby the lack of trust between the two countries can be overcome, by proposing that signature/ratification be a joint action by both States. It is very important for the international community to be attentive to developments of the U.S.-India deal, as it has a direct bearing on the CTBT and the norm against nuclear testing. It is regrettable that the documents relating to civil nuclear cooperation with India which have so far been agreed upon, including the safeguards agreement with the IAEA, have failed to place conditions on India to maintain its test moratorium and have not mentioned the importance of CTBT signature/ratification.

> "It is necessary that the United States resumes its leadership role and commitment to the CTBT as one of the proponents of the Treaty."

Regarding the outstanding Middle East countries, the strategy will not be effective unless it is integrated into the larger peace efforts for the region.

China has openly indicated that it is looking towards the United States before moving to ratification.

Regarding the Democratic People's Republic of Korea (DPRK), as it depends largely on China, it is foreseeable that it will follow suit after the Chinese ratification. In addition, the CTBT will be a logical addition to the DPRK denuclearization commitments under the Six-Party Talks, particularly after the U.S. ratification is secured.

Which brings us now to the United States.

Q: *How important do you consider U.S. leadership in the CTBT ratification process to be?*

A: It is necessary that the United States resumes its leadership role and commitment to the CTBT as one of the proponents of the Treaty. The upcoming elections provide an excellent opportunity to start new lobbying efforts within the policy-making apparatus in the new administration.

The two major presidential candidates have already declared that they would make major changes to the national security and foreign policies carried out by the George W. Bush administration over the last seven years. Although the United States has not conducted a nuclear test explosion since 1992, the Bush administration has not put the Treaty forward for a new vote on ratification to the Senate.

Barack Obama has been clear in his support of the bipartisan group of senior and former government officials who have called for moving toward a "world free of nuclear weapons. He has promised: "As president, I will take the lead to work for a world in which the roles and risks of nuclear weapons can be reduced and ultimately eliminated." Furthermore, he has promised to make the CTBT a priority of his first term

> "... the CTBT will be a logical addition to the DPRK denuclearization commitments under the Six-Party Talks, particularly after the U.S. ratification is secured."

in office and pledged to work to rebuild bipartisan support for the Treaty.

In a recent speech, John McCain also endorsed the concept by stating: "A quarter of a century ago, President Ronald Reagan declared, 'our dream is to see the day when nuclear weapons will be banished from the face of the Earth.' That is my dream, too."

McCain voted against the CTBT in 1999, stating at the time: "The viability of our nuclear deterrent is too central to our national security to rush approval of a treaty that cannot be verified and that will facilitate the decline of that deterrent." However, more recently, he has committed to continuing the moratorium on nuclear weapons testing that has existed since 1992, and promised to take "another look" at the Treaty.

In order to give effect to international arms control and disarmament agreements, States must bring their domestic law into conformity with their obligations under international law. The need to implement national measures was highlighted by the adoption of UN Security Council Resolution 1540 in April 2004. This resolution obliges States to enact and enforce effective laws and supporting measures to prevent the proliferation of nuclear, biological and chemical weapons, related materials and their means of delivery, and to prohibit non-State actors, especially terrorists, from developing and using such weapons.

Costa Rica assumed a non-permanent seat at the UN Security Council on 1 January 2008 and as Chair of the Terrorism/Weapons of Mass Destruction Committee under resolution 1540, it is strongly advocating the enhancement of international security by improving transparency over and assessing the quality of States' national implementation of this resolution.

Q: *For the last two years, special meetings of the Organization of American States (OAS) Committee on Hemispheric Security have been convened, to consolidate the nuclear-weapon-free zone in Latin America and the Caribbean through the Treaty of Tlatelolco, and to promote the full force and effect of the CTBT.*

One of the goals of the OAS is to strengthen peace and security on the continent. As a fellow member of the OAS, what influence can be exerted on the United States to ratify the Treaty?

A: With the welcomed ratification by Colombia in January 2008, the United States is the only country from the OAS Member States listed in Annex 2 of the Treaty whose ratification is still outstanding.

From the very beginning, Costa Rica has sponsored the resolution in support of the CTBT, which has been approved by the OAS General Assembly since 2000. We will continue to work together with other OAS members to exert pressure on the USA to consider ratification as soon as possible, particularly through the Committee on Hemispheric Security.

In this regard, it is very important to achieve the ratification of the remaining five States from the Latin America and Caribbean region (singling out the USA as the only outstanding OAS Member State whose ratification is still pending).

The OAS special sessions have played an important role in keeping the CTBT on the table of international discussions, even at a time when the global situation was not so conducive to its entry into force, and they have also served as a lobbying platform. Further such sessions should serve to foster more synergy with other Washington-based organizations/institutions to create a stronger momentum within the political arena in the USA, particularly in the light of the upcoming elections and later on with the new administration.

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Biographical note

First elected as president of Costa Rica in 1986 and re-elected in 2006, President Oscar Arias has won international recognition as a spokesperson for developing nations and for promoting democracy, human development, demilitarization and disarmament. President Arias played a pivotal role in the signing of the Esquipulas Peace Agreement, which led to the cessation of various conflicts in Central America during the 1980s and for which he was awarded the Nobel Peace Prize in 1987. ■

In the spotlight

Q: *As an active and highly respected member of the international community and with an impressive record of settling disputes, Costa Rica exerts considerable influence on world affairs. What role can you play, as President of Costa Rica and 1987 Nobel Peace Prize Laureate, in encouraging the five remaining States in Latin America – Cuba, Dominica, Guatemala, St Vincent and the Grenadines, and Trinidad and Tobago – to ratify the CTBT?*

A: Through the Tlatelolco Treaty, the Latin American and Caribbean Region took a pioneer step towards international peace and security and constituted the first inhabited region in the world to become a nuclear-weapon-free zone.

The CTBT supersedes the commitments of the Tlatelolco Treaty and establishes a global norm against testing. In addition, it establishes a monitoring system to verify compliance.

I would like to reiterate my personal as well as my country's commitment to promoting disarmament and international peace and security, in line with Costa Rica's traditional policy on these issues, which form one of the pillars of my administration.

In this regard, the Foreign Ministers of the five outstanding States in Latin America have been invited to participate in the upcoming Ministerial Meeting to be held at the end of September 2008 in San José. This has been organized jointly by Austria and Costa Rica in follow up to the Article XIV Conference. In addition, five other States from the region who are strong supporters of the Treaty have also been invited to participate.

Furthermore, Costa Rica will continue to take advantage of bilateral meetings and multilateral fora such as the UN and the OAS General Assemblies to encourage these States to sign and ratify as soon as possible.

Q: *Austria and Costa Rica are currently sharing the presidency of the Article XIV Conference.*

How important is it that two different geographic regions are jointly presiding over the Conference for the first time in the Treaty's history?

A: This shared presidency symbolizes the global support for the Treaty. It testifies that nuclear non-proliferation and disarmament, as well as international security as such, are universal concerns in which each and every Member State of the United Nations is a stakeholder. It also highlights the necessity for world-wide cooperation, a partnership, in the fight against global threats. ■

Notes & quotes

U.S. PRESIDENTIAL CANDIDATES' POSITIONS ON THE CTBT:

Senator John McCain promised to take "... another look at the Comprehensive Test Ban Treaty..." if elected, while speaking at the University of Denver, Colorado, United States, on 27 May 2008.

Senator Barack Obama pledged to "... work with the Senate to ratify the Comprehensive Test Ban Treaty and then seek its earliest possible entry into force," while delivering a speech at the University of Purdue, Indiana, United States, on 16 July 2008.

Voices

Nuclear Testing: A Bygone Era

by Mohamed ElBaradei

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) has been the longest outstanding objective of the nuclear age. Envisaged more than half a century ago in 1954, this goal remains unmet – though a CTBT was successfully negotiated and opened for signature in September 1996.

Virtually all post-World War II U.S. Presidents have grappled with this issue and President Dwight Eisenhower described the failure to achieve a permanent ban on nuclear testing as the greatest disappointment of any administration, of any decade, of any time, and of any party.

Jewel in the crown of nuclear arms control

The CTBT, not surprisingly, has been considered arms control history's longest sought, hardest fought for prize. Achieving the entry into force and implementation of the CTBT would undoubtedly be the jewel in the crown of nuclear arms control and disarmament, supplementing the Nuclear Non-Proliferation Treaty (NPT) and the Fissile Material Cut-off Treaty (FMCT), which is still to be negotiated.

For the past several years, I have been advocating the need to take the bold steps necessary to achieve a world free of nuclear weapons in our time and, in this regard, to fashion a new collective security system that relies not on nuclear weapons, but rather on concepts such as interdependent responsible sovereignty.

Achieving a new collective security system

Achieving such a system requires rebuilding confidence in the authority and integrity of the NPT; securing the entry into force of the CTBT; negotiating a verifiable global FMCT; engineering a new framework for the nuclear fuel cycle; devaluing the role of nuclear weapons through de-alerting; and concrete verified nuclear weapon dismantlement and elimination.

> "The CTBT remains crucial for global security. I believe we owe it to ourselves, we owe it to humanity, we owe it to people everywhere that we do our utmost to have the CTBT come into force as early as we can."

The CTBT is essentially a treaty to end all nuclear explosions permanently, in all environments, for all time. And, there has always been a permanent and indissoluble link between ending nuclear explosive testing and moving down the path of achieving a world free of nuclear weapons

Key role in global security

Why is the CTBT so important? Because it would send a very clear, very concrete signal that the nuclear-weapon States are taking seriously the commitment under the NPT to move towards nuclear disarmament. But more importantly, I think, because it will also make difficult the qualitative development of nuclear weapons and the development of nuclear weapons by new countries.

Without the CTBT it would be tempting for new countries to acquire nuclear weapons without violating legal norms, as we have seen recently. Without the CTBT we might continue to see the qualitative development of nuclear weapons.

Another reason I am concerned about the CTBT not coming into force is because it is unfortunately symptomatic of the slow progress overall with regard to moving towards nuclear disarmament.

The CTBT remains crucial for global security. I believe we owe it to ourselves, we owe it to humanity, we owe it to people everywhere that we do our utmost to have the CTBT come into force as early as we can. ■

Biographical note

Dr. Mohamed ElBaradei has been the Director General of the International Atomic Energy Agency (IAEA) since 1997. An expert in international peace and security and international development, his diplomatic career began in 1964 in the Egyptian Ministry of External Affairs whilst he completed his Doctorate in International Law at the New York University School of Law. Dr. ElBaradei and the IAEA were jointly awarded the Nobel Peace Prize in 2005. ■

Cover story

Nuclear Dangers: The Race between Cooperation and Catastrophe

by Sam Nunn

At the dawn of the nuclear age – after the devastation of Hiroshima and Nagasaki – General Omar Bradley said: "The world has achieved brilliance without wisdom...We know more about war than we know about peace, more about killing than we know about living."

It might surprise General Bradley, if he were alive today, to know that we have made it 60 years without a nuclear attack. We were good, we were diligent, but we were also very lucky.

Making it through 60 years without a nuclear attack should not make us complacent. If we're to continue to avoid a catastrophe, all nuclear powers will have to be highly capable, careful, competent, rational – and if things go wrong, lucky – every single time.

The world is heading in a very dangerous direction

We do have important efforts underway and some important successes, but the risk of a nuclear weapon being used today is growing, not receding. The storm clouds are gathering:

- Terrorists are seeking nuclear weapons, and there can be little doubt that if they acquire a weapon that they will use it.
- There are nuclear weapons materials in more than 40 countries, some secured by nothing more than a chain link fence.
- A number of countries are considering developing the capacity to enrich uranium to use as fuel for nuclear energy, but this would also give them the capacity to move quickly to a nuclear weapons program if they chose to do so.
- Meanwhile, the United States and Russia continue to deploy thousands of nuclear weapons on ballistic missiles that can hit their targets in less than 30 minutes, encouraging both sides to continue a prompt launch capability that carries with it an increasingly unacceptable risk of an accidental, mistaken or unauthorized launch.

The bottom line: The world is heading in a very dangerous direction.

New vision for our global nuclear policy

With these growing dangers in mind, former U.S. Secretaries of State George Shultz and Henry Kissinger, former U.S. Secretary of Defense Bill Perry and I published an op-ed in January 2007, and a follow-up piece in 2008, in *The Wall Street Journal* that called for a different direction for our global nuclear policy with both vision and steps.

The four of us, and the many other security leaders who have joined us, are keenly aware that the quest for a nuclear-weapon-free world is fraught with practical and political challenges. We have taken aim at the practical problems by linking the vision of a nuclear-weapon-free world with a series of steps for reducing nuclear dangers and carving a path towards a world free of the nuclear threat.

Without the bold vision, the actions will not be perceived as fair or urgent. Without the actions, the vision will not be perceived as realistic or possible.

We don't believe our example is likely to inspire Iran, North Korea or al Qaeda to drop their weapons ambitions, but we believe it would become more likely that many more nations will join us in a firm approach to stop the proliferation of nuclear weapons and materials and prevent catastrophic terrorism.

I believe that we cannot defend ourselves against the nuclear threats facing the world today without taking these steps. We cannot take these steps without the cooperation of other nations. We cannot get the cooperation of other nations without the vision and hope of a world that will some day end these weapons as a threat to mankind.

Strategic cooperation against nuclear weapons

This will be a challenging process that must be accomplished in stages. The United States must keep nuclear weapons as long as other

US senior statesmen **George Shultz**, **William Perry**, **Henry Kissinger** and **Sam Nunn** renewed their call for a nuclear-weapon-free world by supporting, among other measures, the adoption of a process for bringing the CTBT into effect, "which would strengthen the Nuclear Non-Proliferation Treaty (NPT) and aid international monitoring of nuclear activities. This calls for a bipartisan review, first, to examine improvements over the past decade of the international monitoring system to identify and locate explosive underground nuclear tests in violation of the CTBT; and, second, to assess the technical progress made over the past decade in maintaining high confidence in the reliability, safety and effectiveness of the nation's nuclear arsenal under a test ban. The Comprehensive Test Ban Treaty Organization is putting in place new monitoring stations to detect nuclear tests – an effort the U.S should urgently support even prior to ratification."

Opinion Editorial, *Wall Street Journal*, 15 January 2008

> "But we will be safer, and the world will be safer, if we are working toward the goal of deemphasizing nuclear weapons and keeping them out of dangerous hands – and ultimately ridding our world of them."

nations do. But we will be safer, and the world will be safer, if we are working toward the goal of deemphasizing nuclear weapons and keeping them out of dangerous hands – and ultimately ridding our world of them.

Strategic cooperation must become the cornerstone of our national defense against nuclear weapons. Even a quick glance at the steps we are proposing in our two *Wall Street Journal* essays reveals that none of the steps can be accomplished by the United States and our close allies alone:

- Changing nuclear force postures in the United States and Russia to greatly increase warning time.
- Reducing substantially nuclear forces in all States that possess them.
- Moving toward developing cooperative multilateral ballistic-missile defense and early warning systems.
- Eliminating short-range "tactical" nuclear weapons.
- Working to bring the Comprehensive Test Ban Treaty into force – in the United States and in other key States.
- Securing nuclear weapons and materials around the world to the highest standards.
- Developing a multinational approach to civil nuclear fuel production, phasing out the use of highly enriched uranium in civil commerce, and halting the production of fissile material for weapons.
- Enhancing verification and enforcement capabilities – and our political will to do both.
- Building an international consensus behind ways to deter and, when necessary, respond strongly and effectively to countries that breach their commitments.

The most difficult and challenging step is the need for redoubling our efforts to resolve regional confrontations and conflicts that give rise to new nuclear powers.

Establishing a durable security relationship with Russia

There can be no coherent, effective security strategy to reduce nuclear dangers that does not take into account Russia – its strengths, weaknesses, aims and ambitions. So, it is remarkable – and dangerous – that the United States, Russia and the North Atlantic Treaty Organization (NATO), have not developed an answer to one of the most fundamental security questions we face: What is the long-term role for Russia in the Euro-Atlantic security arc? Whether caused by the absence of vision, a lack of political will, or nostalgia for the Cold War, the failure of both sides to forge a mutually beneficial and durable security relationship marks a collective failure of leadership in Washington, European capitals and Moscow.

If we are to be successful in dealing with the hydra-headed threats of emerging new nuclear weapon States, proliferation of enrichment, poorly secured nuclear material and catastrophic terrorism – many nations must cooperate. We must recognize, however, that these tasks are virtually impossible without the cooperation of Russia. It is abundantly clear that Russia itself faces these same threats and that its own security is dependent on cooperation with NATO and the United States.

Global security depends on regional security

As NATO prepares for its 60th anniversary, we must address a fundamental question. In the years ahead, does NATO want Russia to be inside or outside the Euro-Atlantic security arc? The same

continues on page 27

Biographical note

Former Senator Sam Nunn is co-chairman and Chief Executive Officer of the Nuclear Threat Initiative (NTI), a charitable organization working to reduce the global threats from nuclear, biological and chemical weapons. He served as a United States Senator from Georgia for 24 years from 1972 to 1996. During his tenure in the U.S. Senate, he was chairman of the Senate Armed Services Committee and the Permanent Subcommittee on Investigations. ■

Feature article

Nuclear Weapons: An Existential Threat to Humanity

by Max M. Kampelman and Thomas Graham, Jr.

Sixty-three years ago last month, the beautiful city of Hiroshima was devastated by the explosion of an atomic bomb. The bomb released the explosive equivalent of 12,500 tons of TNT and killed – outright, or over time by radiation poisoning – nearly 75 percent of the population of that city. Three days later similar devastation was brought to the city of Nagasaki, and a few days after that, the Second World War, the bloodiest and most destructive in the history of humanity, came to an end.

Capability to destroy the Earth several times over

Many thought then, and in subsequent years, that the attacks on Hiroshima and Nagasaki were the harbingers of the future and that nuclear weapons were destined to spread around the world and be part of future wars, threatening the survival of humanity. These views were reinforced by the commencement in a few years of a vast nuclear arms race with both the United States and the Soviet Union rapidly developing the capability to destroy the Earth many times over.

Over 40 States have capacity to build nuclear weapons

President John F. Kennedy was one of those who feared that nuclear weapons would inherit the Earth. There were predictions during his administration that, by the end of the 1970s, there could be as many as 15 to 20 nuclear weapon States in the world, with nuclear weapons fully integrated into national arsenals. If this had happened, there would likely be twice or more that many today. In 2004, for example, the Director General of the International Atomic Energy Agency, Mohamed ElBaradei, asserted that there were more than 40 States in the world that currently could build nuclear weapons, if they so chose. Such a development would have placed the world community in a situation where every conflict would run the risk of going nuclear and there would be no way to keep nuclear weapons out of the hands of terrorist organizations. Such an international security situation would have made today's time of troubles seem like paradise by comparison.

Nuclear Non-Proliferation Treaty prevents catastrophe

Fortunately, such nuclear weapon proliferation did not happen. President Kennedy's darkest fears of catastrophe were not realized. The chief reason that this did not happen was the entry into force of the Nuclear Non-Proliferation Treaty (NPT) in 1970, along with the extended deterrence policies of the United States and the Soviet Union. The NPT converted what had been an act of national pride into an act of international outlawry.

In 1960, after the first French nuclear test in the Sahara, the French newspapers were overflowing with nationalistic sentiment: "Vive La France" and "Vive De Gaulle." Switzerland held two national referenda and the Swiss public twice voted to build nuclear weapons. Sweden had an active nuclear weapons research program. After the NPT was in force, however, when India conducted its first nuclear weapon test in 1974, they were condemned by the entire world and they had to hasten to declare that their nuclear explosion was "peaceful."

184 non-nuclear weapon States agree not to acquire nuclear weapons

The NPT essentially drew the line where the world was in 1970; it recognized five existing nuclear weapon States: the United States, the Soviet Union (Russia), Britain, France, and China. It provided that the rest of the world would agree not to acquire nuclear weapons. And most of the world did agree to that proposition. Today, 184 NPT non-nuclear weapon States are committed to this obligation.

Non-proliferation in exchange for nuclear disarmament

But the NPT did not come as a free gift from the rest of the world to the five nuclear weapon States; rather it is a strategic arrangement founded on a central bargain. That bargain was, and is, non-proliferation in exchange for the sharing of peaceful technology and nuclear disarmament. Nuclear disarmament was perceived by the non-nuclear weapon States as the five nuclear weapon States agreeing over the long term to negotiate away their nuclear arsenals so that ultimately all States would receive equal treatment under the NPT.

A comprehensive nuclear test ban

Since it was recognized that this would take significant time, the non-nuclear weapon States pressed the nuclear weapon States to agree to interim measures to include a comprehensive nuclear weapon test ban, a prohibition on the further production of nuclear explosive material, a significant world-wide reduction in the number of nuclear weapons, and binding obligations not to use nuclear weapons against non-nuclear NPT parties.

None of these measures 40 years later has been realized. One of these measures, which was seen in 1970 as a sort of litmus test which would indicate whether or not the five nuclear weapon States would, over time, live up to their side of the central bargain was a comprehensive nuclear test ban, which was included in the preamble to the NPT. Review conferences failed several times over the years because of disagreement over this issue. When the NPT was made a permanent treaty in 1995, there was a recommitment to conclude a test ban in one year - that is, by 1996. The non-nuclear weapons States' view was, and is, that, if they are going to give up nuclear weapons, the five nuclear weapon States could at least agree to stop testing their weapons.

CTBT rejection contrary to wishes of most Americans

A Comprehensive Nuclear-Test-Ban Treaty (CTBT) was in fact agreed to and signed in 1996, but it was defeated in the U.S. Senate in 1999 and has not yet come into force - some 12 years later and some 40 years after entry into force of the NPT itself. The U.S. Senate's rejection of the CTBT in 1999 was, incidentally, contrary to the wishes of the American public. A poll taken immediately thereafter disclosed that two thirds of the American public disapproved of the Senate's action. This remains a problem.

The next U.S. administration and the CTBT

There are two periods in the four-year cycle of the American presidency when the United States is most likely to review policies and respond to the political exigencies of the moment: during a presidential campaign year when issues are raised, and during the first six months after a presidential election, when a newly-elected or re-elected president is generally empowered to carry out commitments made or judgments held. In that connection, Senator Obama has stated that he will support CTBT ratification and Senator McCain has said he will consider it.

Goal of eliminating nuclear weapons can be realized

Since the publication of two *Wall Street Journal* articles authored by George Shultz, William Perry, Henry Kissinger, and Sam Nunn in January 2007 and 2008 based on President Ronald Reagan's dream to eliminate nuclear weapons worldwide, the world community has taken new hope that some day this objective could actually be accomplished, and the NPT central bargain of non-proliferation in exchange for peaceful cooperation and disarmament finally redeemed. The articles have contributed to paving the way for the realization of the goal of zero nuclear weapons that has been sought since the beginning of the nuclear age. It is recognized that this goal may take a long time to achieve, but for the first time it is actually conceivable - indeed imperative - given the current existential dangers that threaten civilization.

UN can help ensure that the disaster of Hiroshima never happens again

But if there is to be any hope of actually realizing the goal of zero nuclear weapons worldwide, crucial for world security in the long run, it is also essential that the NPT regime not only survive but flourish and act as a real ban against the further proliferation of nuclear weapons. Further, proliferation would substantially derogate from the goal of the elimination of nuclear weapons. The near-term ratification by the United States and entry into force of the CTBT would significantly contribute to the strengthening of the NPT. Thus it must be pursued with urgency. In addition, we must look for other more direct ways to outlaw the further proliferation of nuclear weapons.

Important to the future of the non-proliferation regime, is the utilization of the United Nations, which represents the people of the world. The United Nations should call for the elimination of nuclear weapons as an integral part of human survival. If we want to be absolutely certain that the disaster of Hiroshima will never happen again, then our dedicated objective must be for the United Nations to propose a negotiating schedule to reach a world-wide, verifiable and enforceable agreement on zero nuclear weapons and declare that the development and possession of nuclear weapons is an international crime punishable by total political, economic, cultural, and if necessary, military world isolation and pressure. The continuing role of the United Nations, after this, would then be to prevent and punish violations. This is something that we can achieve and that we must achieve. Let us all work together to help make it happen. It is appropriate and timely for the United Nations to live up to its potential. ■

Biographical note

Ambassador Max M. Kampelman held major negotiating posts under both Democratic and Republican administrations during the 1980s. He served as U.S. Ambassador to the Conference on Security and Cooperation in Europe from 1980 to 1984 and then as Ambassador and Head of the U.S. Delegation to the Negotiations with the Soviet Union on Nuclear and Space Arms in Geneva from 1985 to 1989. Between 1987 and 1989 he also served as Counselor of the Department of State.

Ambassador Thomas Graham Jr. was involved in the negotiation and/or review process of every major international arms control agreement in which the United States participated between 1970 and 1997. These included the Strategic Arms Limitations Talks (SALT) Treaties, the Strategic Arms Reduction Talks (START) Treaties, the Anti-Ballistic Missile (ABM) Treaty, Intermediate Nuclear Force (INF) Treaty, the NPT, Conventional Armed Forces in Europe (CFE) Treaty, and the CTBT.

Both Ambassador Kampelman and Ambassador Graham acted as motivating forces behind and signatories of the opinion-editorial Wall Street Journal *articles: A World Free of Nuclear Weapons and Toward a Nuclear-Weapon- Free World in January 2007 and January 2008 respectively.* ■

Perspectives

The Enduring Value of the Comprehensive Nuclear-Test-Ban Treaty and New Prospects for Entry Into Force

by Daryl G. Kimball

The history of the nuclear age makes it clear that opportunities to reduce the risks posed by nuclear weapons are often very fleeting. When the right political conditions are in place, governmental leaders must seize the chance to make progress.

In 1958 and again in 1963, U.S. and Soviet leaders attempted to negotiate a comprehensive ban on all nuclear test explosions. They came close but failed to seal the deal. While the latter effort led to the 1963 Partial Test Ban Treaty, it took another three decades of on-and-off efforts to conclude negotiations on a comprehensive test ban treaty. During that time, hundreds more underground tests propelled further arms racing and proliferation.

> "The global norm against testing remains strong, for now. Yet the absence of CTBT entry into force also means that the full range of verification and monitoring tools, confidence building measures, and the option of on-site inspections, are not available to help strengthen the international community's ability to detect, deter, and if necessary respond to possible nuclear testing."

Today, the 1996 Comprehensive Nuclear-Test-Ban Treaty (CTBT) remains a vital disarmament and non-proliferation instrument. By prohibiting all nuclear test explosions it impedes the ability of States possessing nuclear weapons to field new and more deadly types of warheads, while also helping to prevent the emergence of new nuclear-armed States.

Moving forward on the CTBT is also an essential step towards restoring confidence in the beleaguered Nuclear Non-Proliferation Treaty (NPT) regime. The nuclear weapon States' commitment to achieve the CTBT was a crucial part of the bargain that won the indefinite extension of the NPT in 1995 and the 2000 NPT Review Conference document.

U.S. Senate's untimely rejection of the CTBT in 1999

Over the years, the importance of the Treaty to global security has only increased and international support has grown. Today, 179 countries have signed the CTBT, and 144 countries have ratified. Unfortunately, the U.S. Senate's brief debate and untimely rejection of the CTBT in October 1999, coupled with the George W. Bush administration's opposition to the Treaty, has slowed the momentum. Nine key States must still ratify to achieve entry into force.

Partially in response to U.S policy on the CTBT, some countries that have signed the CTBT, such as China and Israel, have delayed their ratification processes. Others, including India and Pakistan, have yet to sign the Treaty and are unlikely to do so unless the United States, China, and perhaps other hold-outs, finally ratify.

The situation is self-defeating and counterproductive. Given the U.S. signature of the CTBT and its test moratorium policy, the United States bears most CTBT-related responsibilities. Yet Washington's failure to ratify has diminished its ability to prod other nations to join the Treaty and refrain from testing. At the same time, there is no need—nor is there any political support—for renewed U.S. testing for new nuclear warheads or for any other reason.

Treaty helps prevent regional conflicts and avert nuclear arms race

The CTBT is also needed to help head off and deescalate regional tensions. With no shortage of conflict and hostility in the Middle East, ratification by Israel, Egypt, and Iran would reduce nuclear weapons-related security concerns and bring those States further into the nuclear non-proliferation mainstream. Action by Israel to ratify could put pressure on other States in the region to do so. Iranian ratification would help address concerns that its nuclear program could be used to develop and deploy deliverable nuclear warheads.

Likewise, North Korean accession to the CTBT would help demonstrate the seriousness of its commitment to verifiably dismantle its nuclear weapons program through the Six-Party process[1]. The ongoing India-Pakistan nuclear arms race could be substantially slowed to the benefit of both countries if they signed

[1] The Six-Party talks process aims to find a peaceful resolution to security concerns raised by the North Korean nuclear weapons programme. The process began in response to Democratic People's Republic of Korea's (DPRK) withdrawal from the NPT in 2003 and involve China, the Republic of Korea (South Korea), DPRK, the United States, the Russian Federation and Japan.

and ratified the CTBT or agreed to an equivalent legal instrument.

The global norm against testing remains strong, for now. Yet the absence of CTBT entry into force also means that the full range of verification and monitoring tools, confidence building measures, and the option of on-site inspections, are not available to help strengthen the international community's ability to detect, deter, and if necessary respond to possible nuclear testing.

Moving forward – prospects of ratification by the U.S. Senate

To begin to break the ratification logjam and pave the way for entry into force, leaders in key States must make the right choices in three key areas.

First, it is essential that the next occupant of the White House builds upon growing bipartisan calls for U.S. reconsideration of the CTBT and initiates a serious effort to engage the new Senate on the issue with the goal of winning two-thirds support for ratification by the end of 2010.

Most notably, former Republican Secretaries of State, George Shultz and Henry Kissinger, former Democratic Secretary of Defense, Bill Perry, and retired Democratic Senator, Sam Nunn, have called for a bipartisan push to ratify the CTBT as a key step toward a nuclear-weapon-free world.

U.S. presidential candidates stress importance of nuclear test ban

Most importantly, the two major U.S. presidential candidates have both stressed the importance of a nuclear test ban. Democratic nominee, Senator Barack Obama, has repeatedly expressed support for the CTBT. He said on 16 July 2008 that "…we'll work with the Senate to ratify the Comprehensive Test Ban Treaty and then seek its earliest possible entry into force."

Republican presidential nominee, Senator John McCain, who voted against the Treaty in 1999, said in a speech on 27 May 2008 that, if elected, he would "begin a dialogue with our allies, and with the U.S. Senate, to identify ways we can move forward to limit testing in a verifiable manner that does not undermine the security or viability of our nuclear deterrent. This would include taking another look at the Comprehensive Test Ban Treaty to see what can be done to overcome the shortcomings that prevented it from entering into force." Whether McCain is interested in some new

continues on page 28

Biographical note

Daryl G. Kimball is the Executive Director of the Arms Control Association (ACA) in Washington DC. He previously worked at Physicians for Social Responsibility, which lobbied for the U.S. nuclear test moratorium legislation of 1992. He also served as Director of the Coalition to Reduce Nuclear Dangers, which led NGO efforts to win support for U.S. CTBT ratification. ■

Notes & quotes

"Today, eight nations in the world have declared they have conducted nuclear tests. I am proposing to the international community an action plan to which I call on the nuclear powers to resolutely commit by the 2010 NPT Conference.

Thus I invite all countries to ratify the Comprehensive Test Ban Treaty, beginning with China and the United States, who signed it in 1996. It is time for it to be ratified."

Speech by French President Nicolas Sarkozy, in Cherbourg, France, on 21 March 2008.

Looking for the nuclear needle in the haystack: The Integrated Field Exercise 08 in Kazakhstan

by Kirsten Haupt and Thomas Mützelburg

KAZAKHSTAN HOSTED PREVIOUS EXERCISES ON THREE OCCASIONS IN 1999, 2002 AND 2005.

Against the backdrop of the remote emptiness of the steppe in northern Kazakhstan, a most peculiar scene unfolds: seemingly materializing out of nowhere, figures clad in white plastic overalls pour out of vehicles while at the same time, truckload after truckload of odd-looking contraptions are unloaded. Within a short time, the landscape is speckled with shiny white tents.

What might seem to the unsuspecting onlooker like a scene from a science-fiction movie actually marks the beginning of an inspection exercise carried out by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). This so-called "Integrated Field Exercise 2008" or IFE08 is taking place throughout September 2008 in the former Soviet Union nuclear test site in Kazakhstan's Semipalatinsk Region.

Largest-ever exercise undertaken by the CTBTO

The exercise is unprecedented in scope and size: it involves over 200 participants, consisting of an international team of 40 inspectors, the Kazakh hosts, an evaluation team, observers and an operation support centre in Vienna. In addition, almost 50 tonnes of equipment – the equivalent of six truckloads – have been flown to Kazakhstan. For all its scale and complexity, this exercise bears greater resemblance to a humanitarian aid operation than an inspection under a Non-Proliferation Treaty regime.

The IFE08 is the first comprehensive on-site inspection (OSI) exercise to encompass all phases of a nuclear test detection, from the first suspicious-looking seismic wave appearing on the screens at the CTBTO's International Data Centre (IDC) in Vienna, to the findings presented in the inspection report.

On-site inspections: the ultimate verification measure

An OSI is the ultimate verification measure of the CTBT. Real OSIs will be possible only after the Treaty has entered into force. Until then, all procedures and methods developed for such inspections have to be applied on an experimental basis, and equipment has to be tested for OSIs to be operational when the Treaty enters into force. From then on, the CTBTO must be in a position to launch an OSI at a few days notice because the evidence of a nuclear explosion, such as seismic aftershocks or certain radioactive particles, fades with every passing hour. The CTBTO's OSI team must therefore be veritable logistical wizards.

> "The Integrated Field Exercise is a major priority for us in 2008. It's important for preparing for the entry into force of the Comprehensive Nuclear-Test-Ban Treaty."
>
> CTBTO's Executive Secretary
> Tibor Tóth

The state-of-the-art technical methods that inspectors use on-site are diverse. They may include: multi-spectral imaging, gamma radiation monitoring, visual observation to detect anomalies in the surroundings, monitoring of seismic aftershocks, magnetic and gravitational field mapping,

> "What counts is to show the world that the CTBT's verification system really works."
>
> CTBTO's Executive Secretary, Tibor Tóth

ground penetrating radar and many more. Some of these methods are applied from the air, typically from helicopters.

In spite of this technical sophistication, the OSI regime strikes a careful balance between the ability to detect signs of nuclear testing and safeguarding the national security interest of the inspected Member State. In order for the OSI to be as unobtrusive as possible, the technical methods permitted are prescribed very precisely, even down to which type of radionuclide may be measured for inspection purposes and which must be ignored.

The area to be inspected is also limited to 1000 square kilometres, which is still larger than New York City with its five boroughs – a vast area for a handful of inspectors. Therefore the search for evidence of a nuclear explosion can be the proverbial search for the needle in the haystack!

All OSI procedures are set out in the OSI draft operational manual, which has been worked on since the inception of the CTBTO in 1996, and currently comprises – around 1000 pages including all subsidiary documents.

The final verdict

It is important to note that, according to the Treaty, it is the Member States and not the CTBTO who will pronounce the final verdict on whether a nuclear explosion (and hence a Treaty violation) has indeed taken place. The CTBTO's role will be limited to presenting the technical analysis on which the Member States base their verdict. In light of the constantly increasing sophistication of the verification system, however, these technical findings are likely to become ever more unambiguous.

HELICOPTER OVERFLIGHTS ARE ESSENTIAL TO OBTAIN A GENERAL OVERVIEW OF THE INSPECTION AREA

The system went through its baptism of fire in October 2006, when the Democratic People's Republic of Korea (DPRK) declared

DECONTAMINATION STATION PROCEDURES.

FIELD OFFICERS USING STATE-OF-THE-ART SEISMIC EQUIPMENT.

Phases of Nuclear Test Explosion Detection

Phase 1: The International Monitoring System (IMS) watches for signs of a nuclear explosion

When complete, the International Monitoring System (IMS) will consist of 321 monitoring stations and 16 laboratories worldwide. These 337 facilities will monitor the planet permanently for any sign of a nuclear explosion. 230 of these facilities are already operational. The IMS uses four complementary monitoring methods, utilizing the most modern technologies available. Seismic, hydroacoustic and infrasound stations monitor the underground, the oceans and the atmosphere respectively. Radionuclide stations detect radioactive debris from atmospheric, underground or underwater nuclear explosions.

Phase 2: Transmission of Signals to Vienna

Once one or more stations have detected signals indicating a possible nuclear explosion, relevant data on the time, location and magnitude of the 'event', as CTBT experts refer to it, are transmitted via the Global Communications Infrastructure (GCI) to the CTBTO's headquarters in Vienna. As the GCI uses modern communication technology such as satellites and secure data connections on the ground, it only takes up to 30 seconds for the data to be transmitted to Vienna from the time the station first registers the signal.

Phase 3: Processing and analyzing the data and transmission to Member States

At the IDC in Vienna, scientists process and analyze the incoming data. The raw data and analysis results are then distributed electronically to CTBT Member States all around the world.

Phase 4: Launching an OSI at the request of a Member State

At the request of one or more Member States, the CTBTO launches an OSI in order to clarify whether or not a nuclear explosion has been carried out. During such an inspection, facts are gathered to identify a possible violator of the Treaty.

that it had conducted a nuclear test. Despite the establishment of only two thirds of the IMS monitoring facilities at the time, the CTBTO proved that its verification capabilities already significantly exceeded the expectations of the Treaty's negotiators in 1996.

After the DPRK test, the IFE08 is the next milestone in demonstrating the Treaty's verifiability. ■

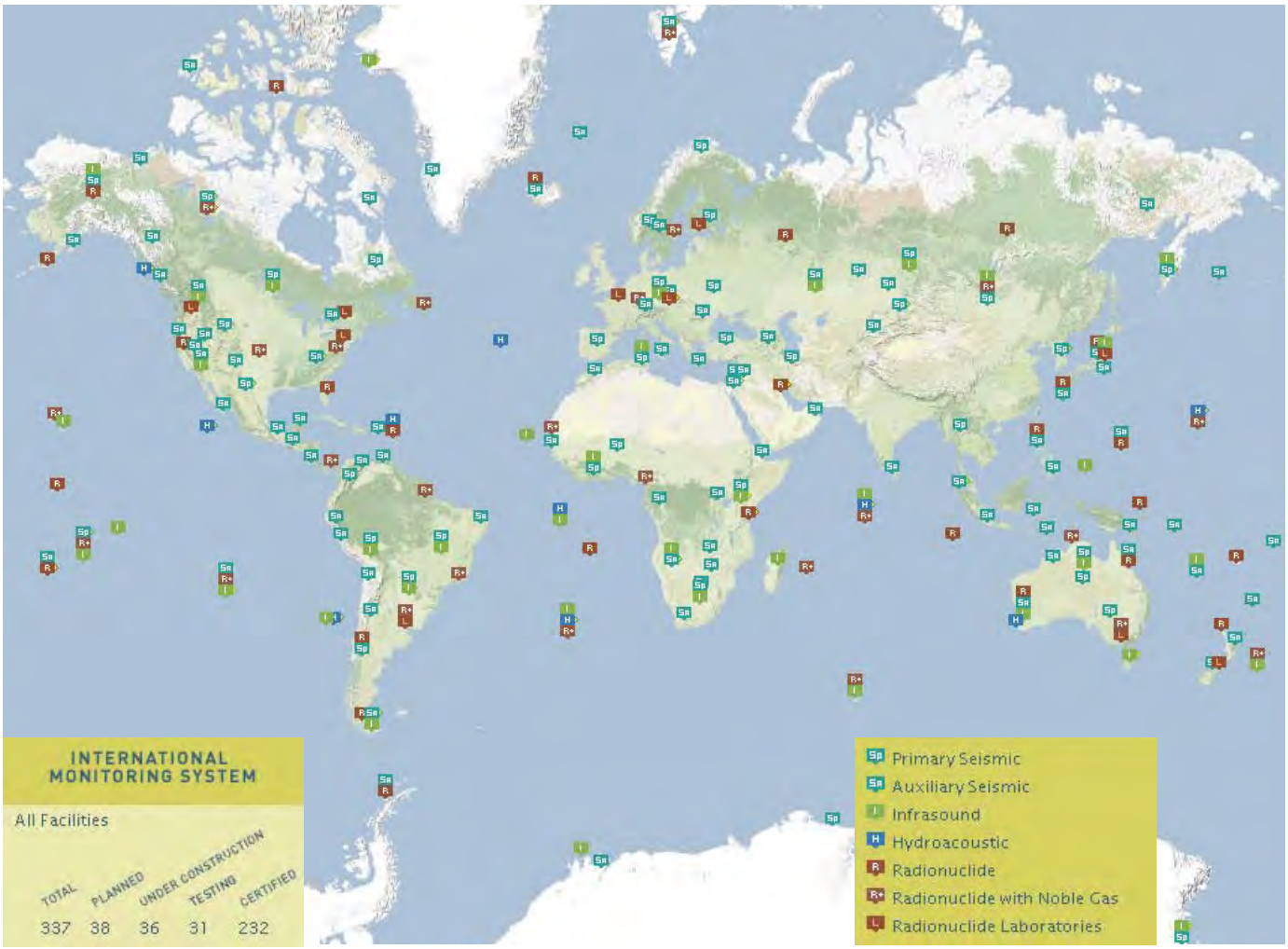
Dr. Kirsten Haupt is a historian who has been working as a Public Information officer at the CTBTO since 2004. Previously, she worked for 11 years in the field of public information in peacekeeping missions in Cambodia and in the former Yugoslavia.

Thomas Mützelburg is a career diplomat with the German Foreign Service. He was the desk officer for the CTBT between 2005 and 2008 and has been seconded to the CTBTO for one year, where he is working in the Public Information section. ■

PREPARING TO FLY A MAGNETIC PROBE. THIS IS ONE OF THE OSI TECHNIQUES THAT WAS EXERCISED IN THE KAZAKH STEPPE IN 2005.

Status of certified IMS facilities

232 certified International Monitoring System (IMS) facilities as of 12 September 2008



Notes & quotes

"The Australian Government has today renewed calls for universal adherence to the Comprehensive Nuclear Test Ban Treaty (CTBT). Its entry into force is an immediate disarmament and non-proliferation priority. The CTBT offers a vital framework for these disarmament and non-proliferation objectives, but a decade after its negotiation it is not yet in force. The Australian Government strongly supports efforts to bring the CTBT into force, and to see the completion of its verification system."

Stephen Smith, Australian Minister for Foreign Affairs,
in a media release issued on 12 May 2008.

Building monitoring facilities in the coldest, driest and windiest continent on Earth: Antarctica

by Denise Brettschneider

JOURNEY THROUGH THE ICE TO PALMER STATION, ANTARCTICA.

"It was the darkness that did it. I don't believe minus seventy temperatures would be bad in daylight, not comparatively bad, when you could see where you were going..." In *The Worst Journey in the World: A Tale of Loss and Courage in Antarctica*, Apsley Cherry-Garrard describes the last expedition to the Antarctic by the explorer, Robert Scott, and his team in 1910.

Total darkness for six months a year

The long periods of constant darkness during the winter contrast starkly with the summer months in Antarctica, when it is light for almost 24 hours a day. Renowned for having the harshest and most extreme environment on earth, the world's lowest temperature of minus 89 degrees Celsius was recorded in 1983 at the Russian (former Soviet) Vostok research station in the centre of East Antarctica. The mean annual temperature of the interior is minus 37 degrees Celsius. And although Antarctica has more fresh water than any other continent, it also receives the least precipitation, with only slightly more rainfall on average than the Sahara Desert.

Its reputation as the windiest and least hospitable continent on Earth is well-deserved. Strong katabatic winds caused by the drainage of cold air down the steep slopes of the ice sheet from the higher interior of the continent, have been measured at over 250 km/h. These winds sometimes ravage the continent for several days. Blizzards are another typical Antarctic phenomenon which can last for a week at a time, reducing visibility to a few feet. Whiteouts, in which there are no shadows or contrasts between objects causing a loss of depth perception, are also commonplace. Explorers have been known to get lost and freeze to death while only metres away from their tents.

Unsurprisingly, Antarctica has never had an indigenous population of humans. Yet its importance as a natural reserve is recognized internationally. Approximately 30 nations, all signatory to the 1961 Antarctic Treaty, send personnel every year to perform seasonal and year-round research on the continent and in its surrounding oceans. The population of scientists varies from approximately 4,000 in summer to 1,000 in winter.

Hostile environment and logistical challenges

In order to provide uniform coverage of the globe, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) has already established several of its monitoring facilities in remote areas that are difficult to access. These facilities are part of the International Monitoring System (IMS) and include a number of stations

in Antarctica: eight seismic, infrasound and radionuclide stations have already been certified by the CTBTO as meeting defined requirements and specifications and another five stations are planned.

The IMS comprises a global network of stations and laboratories that monitor the Earth for evidence of a nuclear explosion in compliance with the provisions of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which bans all nuclear explosions on the planet.

As well as contending with an extremely hostile environment when constructing stations in Antarctica, the CTBTO is also confronted with logistical and engineering challenges: the transportation of installation equipment needs to be meticulously planned and coordinated and stations must be specially designed in order to withstand polar conditions.

There are no developed ports on the continent and only a few locations have a basic wharf facility. Most coastal stations have offshore anchorages, and supplies are transferred by boats, barges and helicopters. Satellite communication is extremely difficult due to the high latitudes — Antarctica is the highest continent in the world, with an average height of 2,400 m above sea level ——and it is only possible from certain research facilities.

DIGGING OUT THE WIND NOISE REDUCING PIPE ARRAY AND EQUIPMENT VAULTS AT IS55.
PHOTO COURTESY OF DUNCAN MARRIOTT, GEOPHYSICAL INSTITUTE, UNIVERSITY OF ALASKA, FAIRBANKS.

Buried in snow

Windless Bight is a desolate ice plain devoid of any vegetation, where temperatures plummet to below minus 40 degrees Celsius. Infrasound station IS55 is part of the IMS and uses very sensitive microbarometers to detect low frequency sound waves which are inaudible to humans. These waves can travel thousands of kilometres and are produced by a variety of natural and man-made sources, including nuclear explosions. The latter events have an identifiable signature which distinguishes them from other types of infrasound sources.

Windless Bight was chosen as a location since, as the name implies, there are virtually no surface winds there in contrast to the rest of Antarctica. In addition, the infrastructure of the Antarctic base that already existed provided crucial support for the establishment of the station.

The site is powered by a hybrid diesel/solar power supply to ensure continuous operations and uses the United States National Science Foundation's (NSF) communication system (which funds and manages the United States Antarctic Programme) to transmit data to Denver, Colorado. The data are then transmitted via the CTBT's Global Communications Infrastructure (GCI) to the International Data Centre (IDC) in Vienna, where they are processed to detect, locate and analyse events. The raw data and analyzed data, so-called IDC products, are transmitted to Member States.

SEA ICE AND STORMS CAN SLOW THE JOURNEY DOWN.

Verification highlights

SHIPPING SUPPLIES AND PERSONNEL TO PALMER STATION
PHOTO COURTESY OF NSF/USAP BY DAVID BRESNAHAN, NATIONAL SCIENCE FOUNDATION.

Windless Bight receives about 1.5 metres of snow accumulation every year. The equipment vaults where the microbarometers are located must, therefore, be dug out every season and replaced on top of the snow. Infrasound waves can generally penetrate the snow for several centimetres with little attenuation (in the presence of attenuation, the signal becomes weaker over distance, i.e. with smaller amplitudes), but when the layer of snow becomes too thick, the risk of attenuation becomes higher. It is therefore also necessary to dig the wind noise reducing system, which is connected to the equipment vaults, out of the snow every year during the annual maintenance of the station.

Communicating with the southernmost point on the surface of the Earth

While the Earth's Polar Regions offer unique scientific research possibilities, their isolation and extreme climates render such opportunities extremely challenging. The North and South Poles are the only places on Earth that cannot see geosynchronous communication satellites because of the distance from the Equator.

In conjunction with the United States Geological Survey (USGS), the IMS operates an auxiliary seismic station at the South Pole – AS114. This station provides data on seismic events to the IDC to supplement information gathered by primary seismic stations. By the time the IMS has been completed, a total of 120 auxiliary seismic stations will have been certified by the CTBTO.

The issue of no satellite coverage for up to 12 hours a day needed to be addressed and the gap has now been filled by satellites belonging to the Iridium network. The Iridium network is a commercial constellation of 66 communication satellites that circle the Earth on pole-to-pole orbits at a height of 780 kilometres. The Iridium network is unique in that it covers the whole Earth, providing communication coverage at the poles from where other satellites are not visible. The CTBTO has collaborated closely with the USGS to develop this service, which has been heralded as a breakthrough in satellite communication technology. Using this network and with the support and assistance of USGS and NSF, AS114 has been able to transmit important seismic data from the South Pole via Denver to the IDC on a 24-hour basis without interruptions since February 2007.

To facilitate operations, the IMS has provided AS114 with a special station interface computer so that it can respond to automatic data requests from the IDC. Despite the remoteness of the station and the climatic extremes, AS114 has now been fully integrated into the IMS.

1,400 km sea voyage from Punta Arenas to Anvers Island

Radionuclide monitoring station RN73 is located at the United States owned Palmer Station on a protected harbour on the south western coast of Anvers Island off the Antarctica Peninsula. The station has been

CTBTO'S COMMUNICATION OFFICER OUTSIDE AS114 AT THE SOUTH POLE.

RE-ATTACHING WIND NOISE REDUCTION PIPE ARRAY TO VAULT AT IS55.
PHOTO COURTESY OF DUNCAN MARRIOTT, GEOPHYSICAL INSTITUTE, UNIVERSITY OF ALASKA, FAIRBANKS.

built on solid rock and consists of two major buildings and three smaller ones, one of which accommodates station RN73, as well as two large fuel tanks, a helicopter pad, and a dock. Palmer Station can occupy a maximum of 46 people and is staffed all year round, although the population during the winter months is usually about 15.

Delivering supplies to stations in Antarctica requires careful planning and access to specially constructed vessels. The Research Vessel R/V Laurence M. Gould, a ship with an ice-strengthened hull designed for year-round polar operations, supports research in the Antarctic Peninsula region by transporting supplies, researchers and staff between Punta Arenas in Chile and Palmer Station. The 1,400 km journey takes approximately four days, although sea ice and storms can slow the journey down.

RN73 is part of a network of 80 radionuclide monitoring stations that enables the continuous worldwide observation of aerosol samples of solid radionuclides or radionuclide particles. The station contains a Radionuclide Aerosol Sampler Analyser (RASA), which is a fully integrated and automatic system for monitoring airborne radionuclides. The meteorological system is located on a mast on the roof of the building and is connected to the RASA computer. It includes sensors to measure temperature, barometric pressure, humidity, precipitation, wind speed and wind velocity. The RASA software controls the station equipment and gathers information about the airflow, air sampler temperature and pressure etc. and meteorological data.

As with IS55 and AS114, this information is sent through the NSF's communication system from Palmer Station to Denver and from there to the IDC via the GCI. RN73 has been transmitting data via the United States to the IDC every two hours since November 2005.

The radionuclide station is operated by General Dynamics - Advance Information Systems (GD-AIS), with the local support of the NSF. The station is unmanned most of the time with a local operator visiting the station at least once every two weeks to perform a physical security and operational check on the RASA.

Complete global coverage

The extreme geographical and climatic conditions in Antarctica mean that installing and maintaining monitoring stations is a costly and complicated exercise. By establishing stations in such places, the IMS network provides complete global coverage, thereby acting as a powerful deterrent to potential violators. ■

Denise Brettschneider is working as a writer and editor with the CTBTO's Public Information section. She has a number of years of editorial experience working for organizations in Kenya including the United Nations Educational, Scientific and Cultural Organization. ■

A Global Scientific Endeavour: The International Scientific Studies Project

by Yvonne Yew

Hydroacoustic technology first evolved at the beginning of the 20th century to increase the safety of sea travel and was soon used for submarine navigation and detection. Nowadays, it also helps in the research of whale populations and their migration patterns, in climate change studies and in tsunami warning systems.

This is one of the cutting-edge technologies – together with seismology, infrasound and radionuclide monitoring – that the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which bans all nuclear explosions on Earth, uses to monitor the planet for evidence of Treaty violations. These four technologies are part of the CTBT's verification regime, which has been established to ensure compliance with the Treaty. The resulting verification data also offer a wide range of civil and scientific applications with the potential to contribute significantly to sustainable development, knowledge expansion and human welfare.

Launched in March 2008, the International Scientific Studies (ISS) project involves a series of independent scientific studies and assessments designed to address the readiness and capability of the CTBT to detect nuclear explosions worldwide. Progress made in all four technologies over the last ten years will be highlighted. The project will examine the performance of the CTBT's global verification system and its ability to detect and locate observed events. It will also evaluate the timeliness, quality and quantity of data which are produced, transmitted, processed and distributed and the effective use of the data for potential civil and scientific applications.

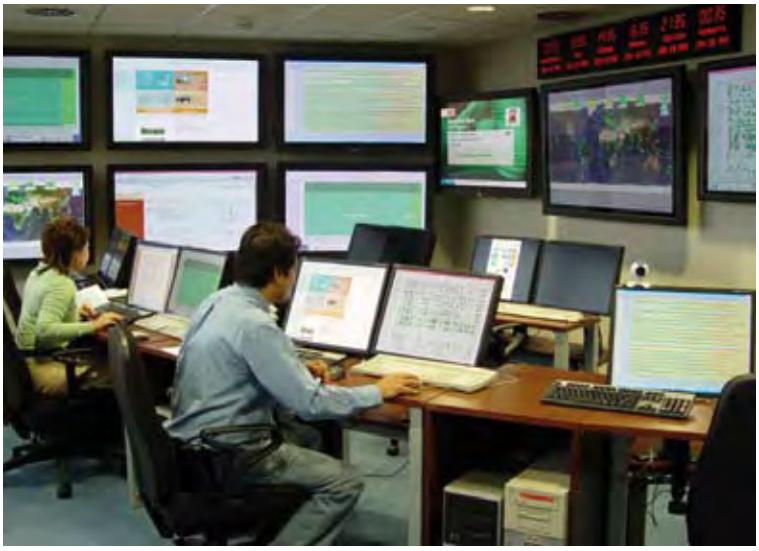
> "To cooperate with science is not a luxury that we can have or not, but a necessity for the long-term sustainability of this organization."
>
> Ola Dahlman, Special Advisor on the ISS project

The project is particularly important since the CTBT's verification regime must be fully operational by the time the Treaty enters into force.

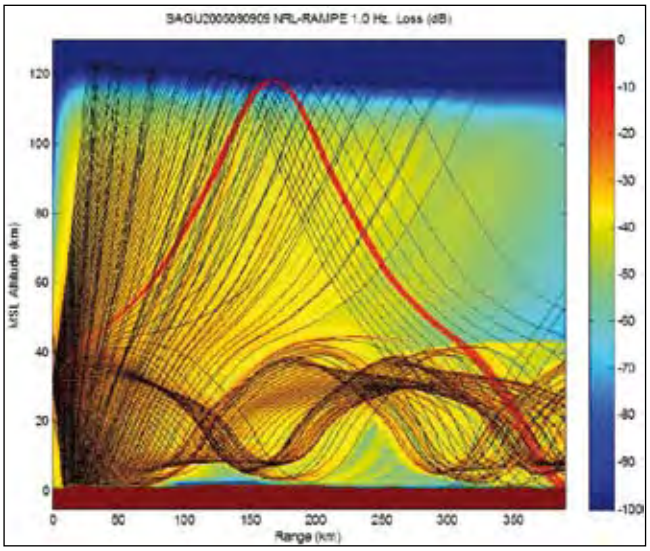
Global undertaking

The project is a global undertaking that is open to experts and institutions from around the world. The CTBTO is the facilitator and coordinator of the project but will not be performing the evaluation. This will be the task of the international scientists and institutions participating in the project. International participation is essential in order to assess the CTBT's verification regime both independently and credibly. The studies and assessments will be carried out between 2008 and 2009, culminating in a final report highlighting the key findings. These findings will also be presented at a large scientific conference in Vienna in June 2009.

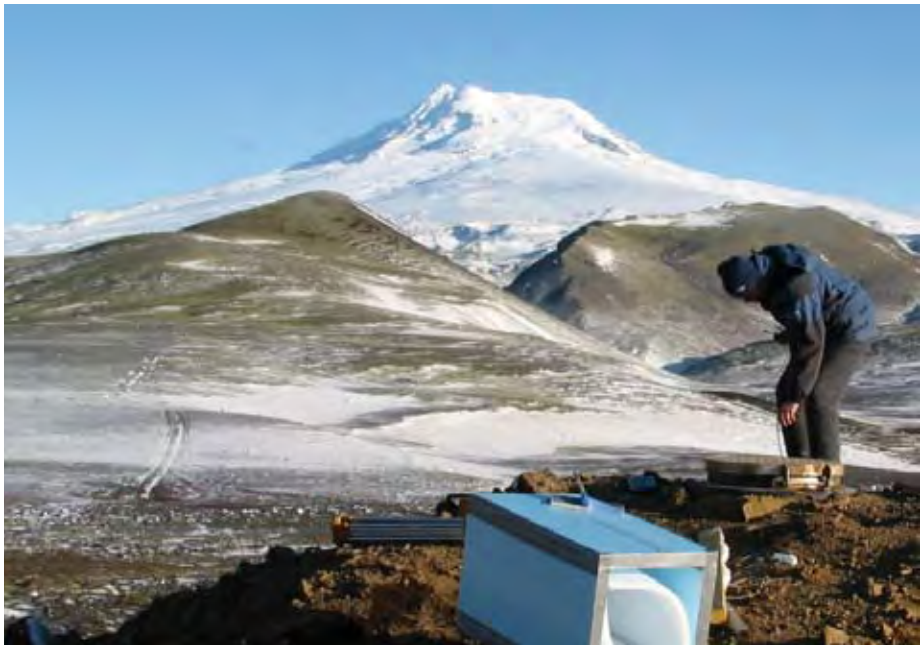
This will be a major priority for the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty



OPERATION CENTRE AT THE IDC, CTBTO HEADQUARTERS, VIENNA, AUSTRIA



INFRASOUND PROPAGATION



SEISMIC STATION AT JAN MAYEN, NORWAY

Organization (CTBTO) in its 2009 calendar. Keynote addresses across relevant disciplines, presentations, round-table discussions and poster sessions are envisaged at the conference. The conference results will be published in August 2009 and its comprehensive findings could assist Member States in their assessment of the verifiability of the Treaty.

Capacity building

It is the CTBTO Member States that are responsible for making an assessment of the data received from the CTBTO's International Data Centre (IDC). As such, it is important for States to increase their technical knowledge base, as well as develop the facilities needed to participate fully in the implementation and monitoring of the Treaty. In maintaining and developing the CTBT as a global Treaty, the ISS project contributes to the capacity building potential of Member States.

Civil and scientific benefits

There are many potential applications of the CTBT's verification data in addition to those mentioned earlier. These include research on ocean processes and marine life; volcanic eruption monitoring for aviation safety; and research on the structure of the Earth, its oceans and the atmosphere. By rapidly acquiring and disseminating data on earthquakes, especially tsunami-generating earthquakes, seismic data can also assist in disaster management and response efforts, thus helping to save lives.

For CTBT verification data and technologies to be used most effectively for civil and scientific purposes, the exchange of ideas needs to be encouraged. An on-going dialogue with the scientific community helps raise awareness about the considerable scientific and technological advances which are of relevance to the CTBT. An analysis of these developments in relation to the establishment of the Treaty's verification regime is of immense importance. Through the ISS project, this mutually beneficial relationship between the CTBTO and the global scientific community is being developed and strengthened continuously.

International interest

Several phases have been planned for the ISS project leading up to the 2009 Conference. The Planning Meeting took place in March 2008 and concluded the first phase of the ISS project. Over 100 experts and officials from 33 countries participated, reflecting the great interest generated by the project. The meeting discussed scientific work on eight topic areas that were identified as relevant to the ISS studies: system performance, seismology, hydroacoustics, infrasound, radionuclides, atmospheric transport modelling, on-site inspections, and data mining.

The ISS has now progressed beyond its planning phase. Scientific studies and research projects are currently being undertaken by the participating scientific institutions. Several planned ISS-related workshops and PTS activities will also feed into the ISS process, including the findings related to the On-Site Inspection Integrated Field Exercise (IFE08) that is taking place in September 2008, at Semipalatinsk, Kazakhstan (*see article on page 14*).

The ISS project is an inclusive and dynamic process. It continues to remain open to experts and institutions with relevant interests in the Treaty's verification technologies. ■

Yvonne Yew is a consultant with the CTBTO working on the ISS project. Prior to this, she was a career diplomat with the Singapore Foreign Service covering regional and multilateral issues including the International Atomic Energy Agency's Board of Governors meetings from 2004 to 2006. ■

Verification science and potential civil applications

The importance of Atmospheric Transport Modelling: Over ten years of cooperation between the World Meteorological Organization and the CTBTO

by Peter Chen, Gerhard Wotawa and Andreas Becker

FACT BOX – ATMOSPHERIC TRANSPORT MODELLING (ATM)

ATM is an integral part of radionuclide monitoring, which is carried out by the CTBT's radionuclide facilities that belong to the International Monitoring System. Radionuclide monitoring technology is complementary to the three waveform verification technologies – seismic, infrasound and hydroacoustic – employed by the Comprehensive Nuclear-Test-Ban Treaty's (CTBT) verification regime to monitor compliance with the Treaty. While waveform monitoring is utilized for event detection and location and could be used to differentiate between an earthquake and an explosion, detecting relevant radionuclides or noble gases is essential for the unambiguous identification of the nuclear origin of an event. Radionuclide technology combined with ATM thus provides the means to identify the "smoking gun" needed to prove a possible violation of the Treaty. With its "forensic proof" of nuclear explosions, radionuclide technology is of crucial importance to the entire verification effort.

When high levels of radiation (caesium-137) set off alarms at the Forsmark Nuclear Power Plant in Sweden on 26 April 1986, the world was taken by surprise. There had been a complete melt down of the reactor core at a nuclear power plant in Chernobyl in the Soviet Union, on 25 April at 21:23 local time. Over the next 10 days, the amount of radioactive caesium[1] released into the atmosphere amounted to 10 percent of all the caesium injected into the environment during the entire period of atmospheric nuclear testing between 1945 and 1980.

Major advances in ATM calculations since Chernobyl

At the time of the Chernobyl nuclear accident, provisions for near-real-time ATM calculations, which would have helped to detect the source of the caesium radionuclides earlier, hardly existed.

Nowadays, the measurement of radionuclides with concentrations dramatically lower than the 1986 values detected in Sweden would trigger a swift response: several World Meteorological Organization (WMO) Centres would be requested to supply atmospheric backtracking calculations to the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) to supplement their own calculations. In the event of an anomalous radionuclide being detected, the CTBTO's International Data Centre (IDC) staff would try to identify its possible source region and then provide Member States with relevant information.

ATM backtracking reveals sources of radionuclides

This was the case when measurements of caesium as low as one micro-Becquerel[2] per m3 were detected in northern Canada between 2003 and 2004. They were analyzed carefully by the IDC and traced back to forest fires in Siberia and Alaska. The burnt trees had taken up the caesium decades earlier during nuclear testing and later during the Chernobyl accident. This study was carried out in cooperation with experts from the WMO Centre in Montreal and other organizations in Canada.

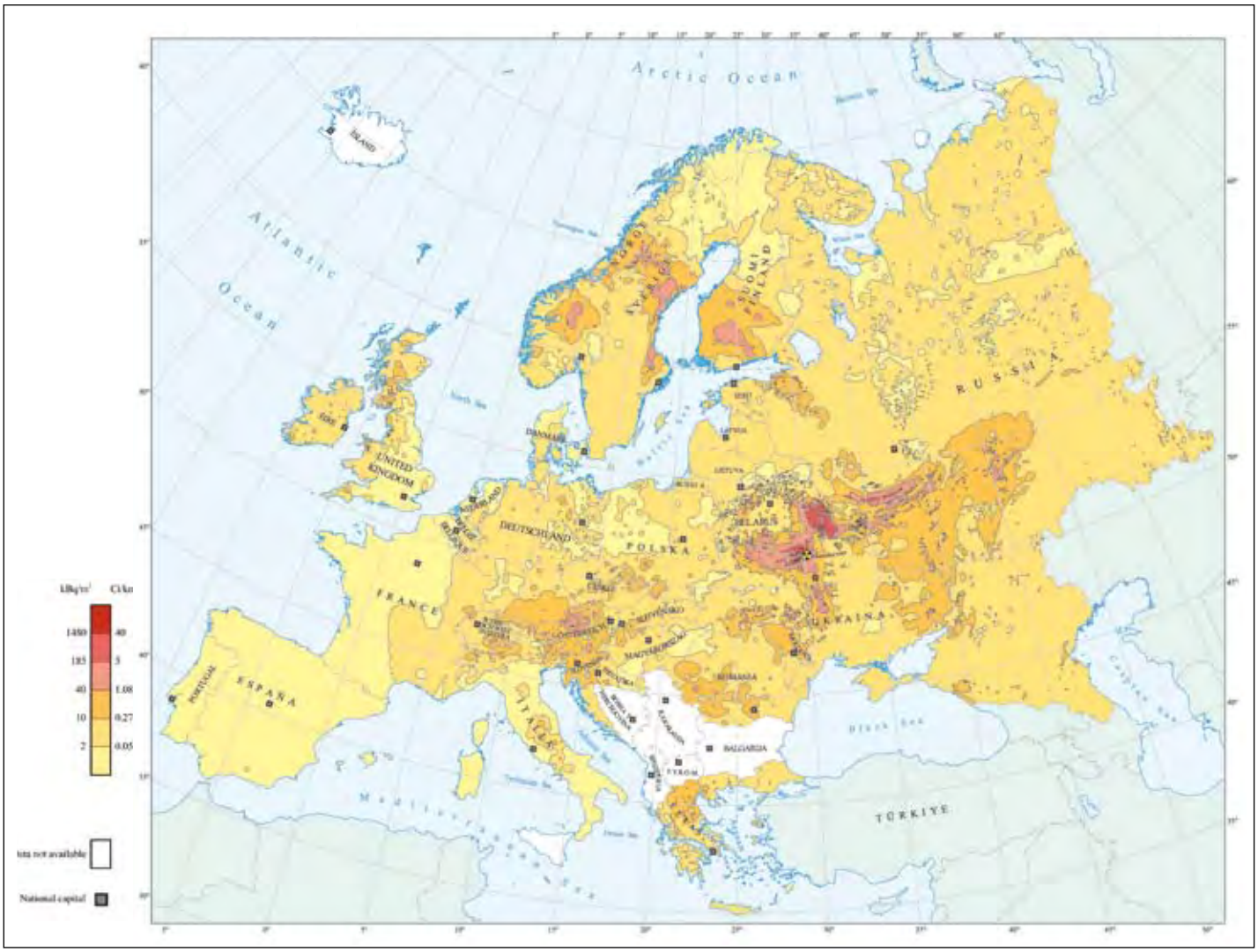
Another example illustrating the importance of ATM backtracking was when the Democratic People's Republic of Korea (DPRK) announced that it had conducted a nuclear test on 9 October 2006. Two weeks later, the CTBTO's International Monitoring System (IMS) radionuclide noble gas station at Yellowknife, Canada, registered an unusually high concentration of xenon[3] 133 (in the order of milli-Becquerel per m3). Applying ATM to backtrack the dispersion of the gas, the noble gas detection at Yellowknife was found to be consistent with a hypothesized release from the event in the DPRK.

Potential civil, humanitarian, and scientific applications

These cases illustrate the importance of ATM technology: it is not surprising that this is the key area among meteorological applications in which the CTBTO and WMO work together. In addition to emergency response, data from the CTBT's IMS have been useful in other areas such as disaster mitigation. In 2007, for instance, the CTBTO entered into a collaborative project with WMO, involving one of its centres at Toulouse, France, which has been designated as an International Civil Aviation Organization (ICAO) Volcanic Ash Advisory Centre (VAAC).

Volcanic ash represents a serious aviation hazard. Its prompt detection and location through the use of infrasound data and the prediction of its movement through forward ATM calculations can be very useful. Such information provides aircraft with early warnings of possible airborne ash plumes and could also provide guidance for air traffic re-routing decisions. The exploratory phase of this project covers selected volcanoes in the European and African regions and some initial contacts have been established with other

[1] Caesium (or cesium) is a soft, silvery-gold alkali metal with a melting point of 28° C.Radioactive forms of caesium are produced by the fission of uranium in fuel elements during the normal operation of nuclear power plants, or when nuclear weapons are exploded.
[2] Becquerel is the amount of radioactive material in which 1 atom transforms every second.
[3] Xenon is a chemical element in gaseous form, which is called a noble gas since it is inert and rarely reacts with other chemicals. Several of its radioactive isotopes, of which one of the isotopes is xenon-133, can only be produced by a nuclear reaction and are therefore measured to detect clandestine underground nuclear explosions.



SURFACE GROUND DEPOSITION OF CAESIUM-137 RELEASED IN EUROPE AFTER THE CHERNOBYL ACCIDENT.
ILLUSTRATION COURTESY OF EC/IGCE, ROSHYDROMET (RUSSIA)/MINCHERNOBLY (UKRAINE)/BELHYDROMET (BELARUS), 1998.

VAACs to extend the investigations to other regions in the world.

ATM also plays an important role in the CTBTO's International Scientific Studies project *(see article on page 22)*, which aims to estimate the capabilities of current ATM procedures and explore ways of further improving their accuracy. WMO acts as the Topic Coordinator for ATM in this project. Future cooperation may be extended to other important areas such as climate change.

WMO's role in the design of the CTBT's radionuclide network

Even before the formation of the CTBTO, WMO and several of its members were involved in the design of the CTBT's radionuclide network. During the CTBT negotiations from 1994 to 1996, the Group of Scientific Experts (GSE) that had been created to lay the scientific and technical ground for the Treaty negotiations, conducted several global experiments in international data exchange. WMO provided its Global Telecommunications System (GTS) for use in these exchanges.

At the same time, ATM was used together with historical global weather data to simulate the spread of airborne radionuclides in various fictitious atmospheric explosion scenarios. The results enabled the GSE to make significant advances towards designing what later became the model for the current IMS, especially the

ATM is an advanced computer-based technology for the calculation of the travel path of a given radionuclide, using meteorological data. This calculation can be performed in one of two ways:

- As **backtracking ATM**, which tries to identify the area from which a radionuclide may have been released calculated from the location where it was observed; or as
- **Forward ATM**, which predicts where radionuclides may travel from their known point of release.

Verification science and potential civil applications

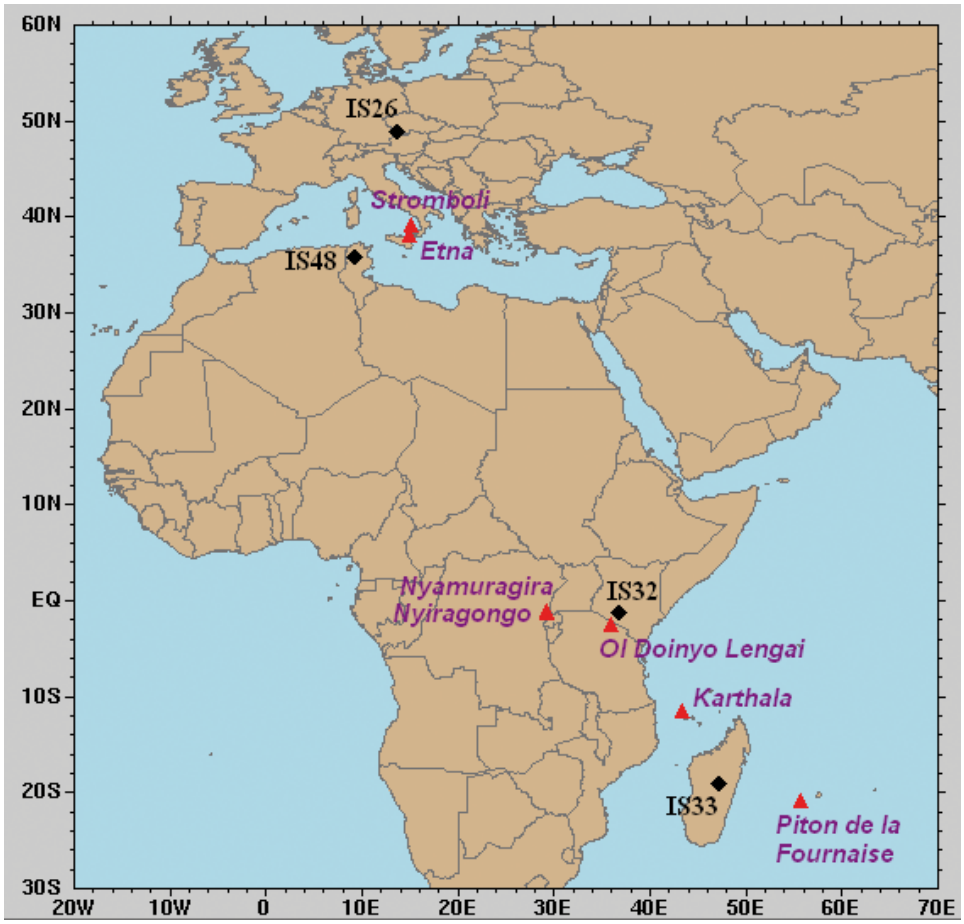
final configuration of the CTBT's radionuclide network. WMO also conducted research on the use of measurement-based ATM to determine the possible source region of an airborne material detected at the surface of the Earth, and presented its findings to the Treaty negotiators.

The "Informal Meeting to Discuss the Applications of Atmospheric Modelling to CTBT Verification" hosted by the WMO Centre in Canada, also provided a forum for scientists to exchange ideas and ongoing research that were thought at the time to contribute to ATM applications for Treaty verification.

Mutual organizational arrangements

Prior to the establishment of the CTBTO, Ambassador Wolfgang Hoffmann of Germany, who became the CTBTO's first Executive Secretary in March 1997, contacted WMO to explore the possibility of applying ATM in conjunction with radionuclide technology as part of the proposed IMS. This would enhance Treaty verification and would mean that the proposed monitoring system would not rely primarily on seismic monitoring, as had been foreseen initially.

A small WMO-CTBTO task group also reviewed possible areas of technical cooperation between the two organizations in 1998 and identified mutual benefits in ATM and potential data exchange. WMO's Commission for Basic Systems, the technical commission responsible for the World Weather Watch Programme, first invited CTBTO representatives to its meetings of technical experts involved with ATM technologies in 1999. These meetings initially focused on environmental emergency response such as in the event of a nuclear accident, later incorporating new requirements related to CTBT verification.



SELECTED VOLCANOES (RED TRIANGLES) UNDER RESPONSIBILITY OF VAAC IN TOULOUSE AND IMS INFRASOUND STATIONS USED FOR DETECTION REVIEW (BLACK DIAMONDS).

Joint activities and exchange of data and expertise

The two organizations formalized their cooperation in an agreement in 2000, which entered into force in May 2003 after approval by the CTBTO and the WMO Congress. The exchange of data and expertise within this framework has greatly contributed to the work of both organizations.

Below are a few examples of this collaboration, which dates back to 2002 in anticipation of the agreement entering into force:

- Continuous provision of meteorological data measured at the Treaty's radionuclide stations by the CTBTO to WMO since 2002. These data are then distributed globally through WMO's GTS.
- First coordinated experiment between the organizations on source region estimation in 2003. This was a major breakthrough in terms of real-time data exchange and analysis and was repeated in 2005.
- Agreement by the CTBTO, in principle, in early 2005 to release IMS data on natural radionuclides for WMO Programmes (see *Spectrum 7*, December 2005). These data

The Race between Cooperation and Catastrophe

by Sam Nunn

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can be used for the verification of weather models as well as for science and research.

- Inclusion of the CTBTO-WMO response system for atmospheric backtracking in the WMO Manual for the Global Data Processing and Forecasting System in 2007. A third joint exercise was conducted in December 2007 to perform a final verification of this response system, which became operational on 1 September 2008

- Joint article on quality assessment of ATM backtracking in support of CTBT verification, published in *Atmospheric Environment* 41 (2007) pp 4520-4534.

This article will continue in the next edition of Spectrum, describing in more detail the 2007 CTBTO-WMO exercise mentioned above and other ongoing activities. ■

Biographical note

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Dr. Gerhard Wotawa is a specialist in the modelling of atmospheric chemistry and transport. He joined the CTBTO in October 2000 and currently works as an Atmospheric Sciences Officer at the IDC.

Dr. Andreas Becker is an Atmospheric Sciences Officer in charge of ATM software development at the IDC. He joined the CTBTO in 2001 and is a specialist in the field of coupling of ATM systems in support of environmental measurement campaigns. ■

> "The common interests of the United States, Europe, Russia, China, Japan, and many other nations are more aligned today than at any point in modern history. I believe that we must seize this historic opportunity and act accordingly."

question, of course, must be asked by the Russians. If our answer is outside, then it's simple – we both just keep doing what we are now doing. If the answer is inside, we and Russia must make adjustments in strategy and tactics.

The common interests of the United States, Europe, Russia, China, Japan, and many other nations are more aligned today than at any point in modern history. I believe that we must seize this historic opportunity and act accordingly.

Bottom line: In an age fraught with the dangers of nuclear proliferation and catastrophic terrorism, global security depends on regional security. Twenty years after the fall of the Berlin Wall, establishing a more cooperative and productive relationship with Russia will require Europe's leadership as well as the United States'.

A world free of nuclear weapons

The reaction of many people to the vision and steps to eliminate the nuclear threat comes in two parts – on the one hand they say: "That would be great." And their second thought is: "We can never get there."

To me, the goal of a world free of nuclear weapons is like the top of a very tall mountain. It is tempting and easy to say: "We can't get there from here." It is true that today in our troubled world we can't see the top of the mountain.

But we can see that we are heading down – not up. We can see that we must turn around, that we must take paths leading to higher ground and that we must get others to move with us.

Nearly 20 years ago, U.S. President Ronald Reagan asked an audience to imagine that "all of us discovered that we were threatened by a power from outer space—from another planet." The President then asked: "Wouldn't we come together to fight that particular threat?" After letting that image sink in for a moment, President Reagan came to his point: "We now have a weapon that can destroy the world -- why don't we recognize that threat more clearly and then come together with one aim in mind: how safely, sanely, and quickly can we rid the world of this threat to our civilization and our existence."

If we want our children and grandchildren to ever see the mountain top, we must begin to answer this question. ■

The Enduring Value of the Comprehensive Nuclear-Test-Ban Treaty and New Prospects for Entry Into Force

by Daryl G. Kimball

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test limitation initiative or will eventually find a way to endorse the 1996 Treaty is not clear.

It is clear that in order to gain the necessary support for ratification, the next U.S. president must do more than study the CTBT and should not try to renegotiate or amend it. A full-scale effort will require strong presidential leadership, a high-level CTBT coordinator, and an effective NGO advocacy campaign.

> "... it is incumbent upon each of the world's major nuclear suppliers and CTBT signatories to unequivocally state that if India tests, they would terminate nuclear trade with India. Each also has a responsibility to actively seek India's early consideration and support for the CTBT."

High-level diplomatic pressure must continue on "hold-out" States

Second, leaders of States committed to the CTBT must exercise much more consistent, top-level diplomacy in support of entry into force. The numerous statements by individual governments and regional groupings of States are essential but are not sufficient. Too often, they fail to press their counterparts in the nine CTBT hold-out States.

One important opportunity will be the "Friends of the CTBT" Foreign Ministers meeting in New York this September, when foreign ministers from CTBT ratifying States will gather to issue their biennial joint statement calling for the Treaty's entry into force. Another is the next Conference on Facilitating the Entry into Force of the CTBT, likely to take place in the fall of 2009, to help prod the U.S. president and other hold-outs to approve the Treaty. China merits special attention. For years, Beijing has reported that the Treaty is before the National People's Congress for consideration but has apparently taken no action to win legislative approval.

U.S. nuclear trade with India

Unfortunately, the 45 participating countries of the Nuclear Suppliers Group (NSG) failed a third important leadership test on the CTBT when they approved an India-specific waiver from NSG guidelines on 6 September 2008 without any call for New Delhi to translate its political pledge not to test into a legally-binding and enforceable commitment by joining the CTBT.

Worse still, the United States, France, the United Kingdom, and Russia, each of whom stand to profit from nuclear trade with India, opposed a group of six responsible like-minded NSG States, plus Japan, that sought to establish a clear and unambiguous NSG policy to terminate trade if India resumes testing.

Following the NSG's reluctant approval of the India-specific waiver, several States delivered national statements to clarify their views on how the NSG's policy on India should be implemented. Japan, and perhaps others, noted that if India resumed testing, "the logical consequence is to terminate trade."

Indeed, paragraph 3 of the NSG statement undeniably says the "basis" of the India specific waiver is the July 2005 pledge and the 5 September 2008 statement by India's External Affairs Minister, Pranab Mukherjee, which included a pledge to maintain India's nuclear test moratorium.

To address the severe shortcomings of the NSG's decision, it is incumbent upon each of the world's major nuclear suppliers and CTBT signatories to unequivocally state that if India tests, they would terminate nuclear trade with India. Each also has a responsibility to actively seek India's early consideration and support for the CTBT. If, as Prime Minister Manmohan Singh said in July 2005, India is prepared to take on the responsibilities expected of other advanced nuclear nations, it is reasonable to expect that India should agree to a legally-binding test moratorium, as the five original nuclear-weapon states have all done.

Securing the Treaty's entry into force

CTBT entry into force is within reach. With the 2008 U.S. election and the 2010 NPT Review Conference approaching, it is vital to redouble efforts to secure ratification by key CTBT hold-out States, accelerate work to complete the International Monitoring System, and avoid developments that would damage the CTBT regime. The next one to two years may represent the best opportunity to secure the future of this long-awaited and much-needed Treaty. ■

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