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# CTBTO SPECTRUM

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PRESIDENT OF BURKINA FASO **BLAISE COMPAORE**

FOREIGN MINISTER  
OF HUNGARY

**JÁNOS  
MARTONYI**

FOREIGN MINISTER  
OF INDONESIA

**MARTY M.  
NATALEGAWA**

FOREIGN MINISTER  
OF ICELAND

**GUNNAR BRAGI  
SVEINSSON**

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

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

As of September 2013, 183 countries had signed the Treaty and 159 had ratified. Of the 44 nuclear capable States which must ratify the CTBT for it to enter into force, the so-called Annex 2 countries, 36 have done so to date while eight have yet to ratify: China, the Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan and the United States.

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

The regime must be operational when the Treaty enters into force. It will consist of 337 monitoring facilities supported by an International Data Centre and on-site inspection measures. As of 3 September 2013, 87 percent of the facilities of the International Monitoring System (IMS) were operational.

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## EDITORIAL

### LASSINA ZERBO

#### CTBTO EXECUTIVE SECRETARY



*I am pleased to present my first issue of Spectrum as the Executive Secretary of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). With my new responsibility comes a deep sense of gratitude and commitment. Gratitude for the trust that States Signatories have placed in me; commitment to achieving the entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), building on the excellent work of my predecessors, Tibor Tóth and Wolfgang Hoffmann.*

*In this issue, I am proud to see an article by President Blaise Compaoré of Burkina Faso. President Compaoré was the first head of state to address the CTBTO's executive body in June this year. In his article, he underscores that the CTBT "has already been recognized as an international standard" and "that the time has come to strengthen this standard by making the CTBT legally binding and universal."*

*On 27 September 2013, foreign ministers from the 183 CTBT Signatory States will gather in New York to push for the Treaty's entry into force at the Article XIV conference. The conference will be presided over jointly by the Foreign Ministers of Hungary and Indonesia, János Martonyi and Marty Natalegawa, who describe in this issue how they will advance this process over the next two years.*

*The conference comes on the eve of a significant anniversary: the 50<sup>th</sup> anniversary of the Partial Test Ban Treaty (PTBT). The PTBT came into effect on 10 October 1963. The treaty's negotiators sought a complete ban on nuclear tests; this did not, unfortunately, materialize. While the PTBT can be credited with addressing the issue of fallout from atmospheric testing, nuclear testing continued underground, enabling an increasing number of countries to develop nuclear weapons for the first time or to increase the destructive power of their existing arsenals. Today, with half a century's hindsight, we have to ask ourselves how much longer it will take to finish the job and achieve a complete ban on all nuclear tests.*

*This issue introduces the newly established Group of Eminent Persons (GEM), a group of personalities of international standing and renowned experts who will reinforce the Article XIV process. It is my hope that through their vast expertise and experience, the members of this group will help make headway towards the CTBT's entry into force, which Iceland's Foreign Minister Gunnar Bragi Sveinsson describes in his article as "a realistic working goal".*

*Sveinsson also highlights the usefulness of CTBT data for disaster mitigation for Iceland, a country known for its volcanic and seismic activity. CTBTO seismic data are of special interest to Miaki Ishii from Harvard University, who relates how natural or man-made seismic events help her study the Earth's inner structures, down to its innermost core. She further explains how a better understanding of the Earth's inner structures in turn improves the detection of nuclear explosions. This is a perfect example of how the CTBT verification regime and the broader scientific community can benefit from each other.*

*The CTBT: Science and Technology 2013 Conference (SnT2013) held in June in Vienna helped to further strengthen*

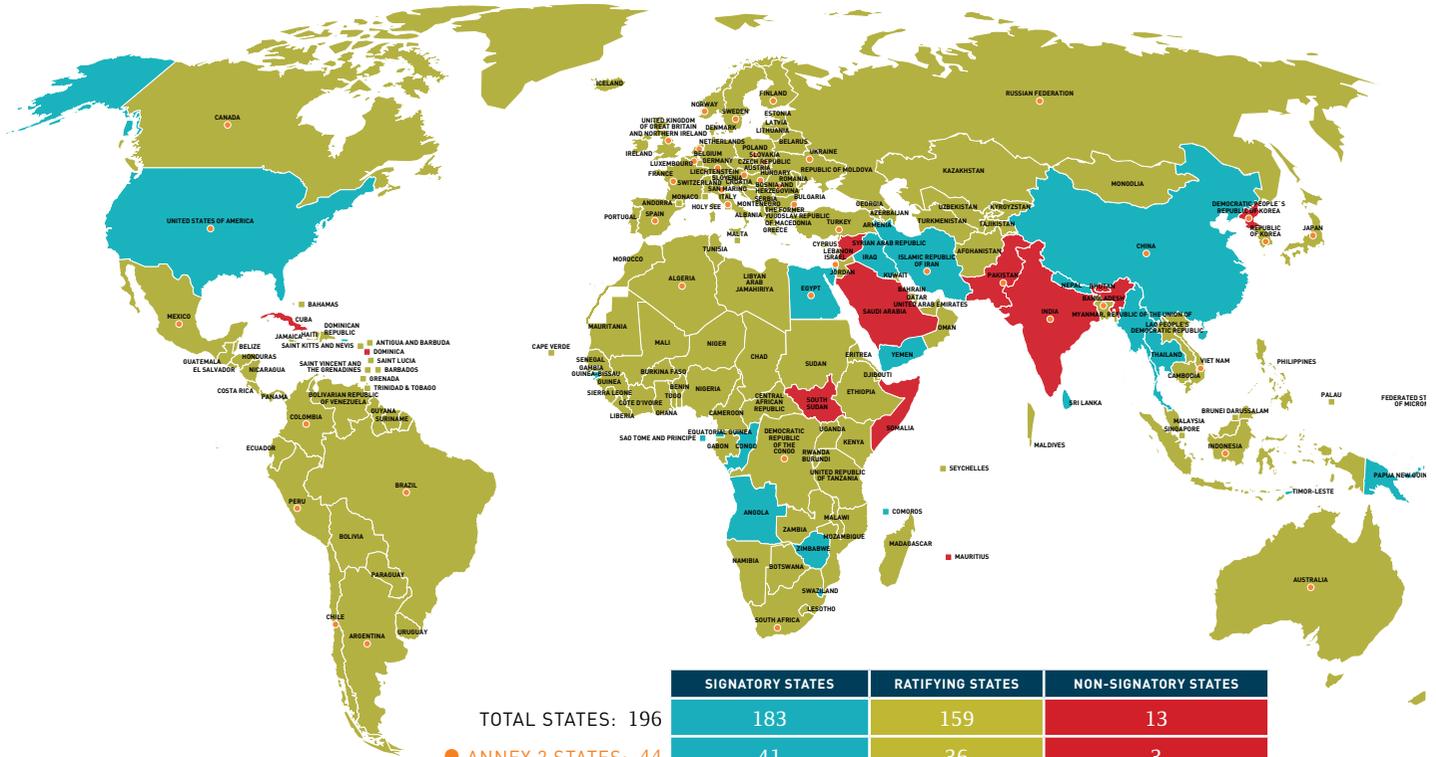
*this relationship. Excerpts of the keynote addresses are presented in this issue. A prominent topic at the conference was the impact of emissions by producers of radioactive isotopes used in nuclear medicine on the detection of nuclear explosions. At the conference the Belgium-based Institute for Radioelements (IRE), one of the world's major radiopharmaceutical producers, signed a pledge to cooperate with the CTBTO to mitigate the effects of such emissions. An article on 'Joining forces to address radionuclide emissions' describes the background and significance of this development.*

*Perfecting on-site inspection techniques (OSI), in line with the CTBTO's Medium Term Strategy, was an underlying theme at the SnT2013. The conference discussed the potential of multi-spectral imagery for CTBT verification, in particular for on-site inspections, which CTBTO's Aled Rowlands elaborates on in his article. Multi-spectral imagery was one of many techniques exercised during the latest OSI Build-Up Exercise, the final rehearsal for the next fully-integrated field exercise (IFE14) in Jordan in November 2014.*

*IFE14 will bring the CTBTO's readiness to conduct OSIs to a new level. However, this increasingly powerful verification tool remains idle pending the CTBT's entry into force. The last wake-up call was the February 2013 nuclear test announced by the Democratic People's Republic of Korea. As UN Secretary-General Ban Ki-moon declared in his welcoming address at the Science and Technology 2013 Conference: "The science and technology behind the Treaty's implementation are proven. Now it is time for the international community to exercise political will and act."*

A handwritten signature in blue ink, appearing to read 'L. Zerbo', with a long horizontal flourish extending to the right.

# STATUS OF SIGNATURES AND RATIFICATIONS AS OF 3 SEPTEMBER 2013



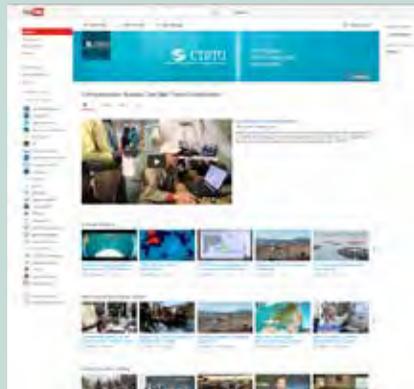
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Photo courtesy of Foreign and Commonwealth Office

## VOICES

# Burkina Faso's commitment to peace and security

BY PRESIDENT BLAISE COMPAORÉ  
OF BURKINA FASO

**On 13 June 2013, President Blaise Compaoré of Burkina Faso became the first head of state to address the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization.**

**Below is a slightly abridged version of President Compaoré's address.**

It is a real pleasure for me to take part in this 40th session of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) here in the historic city of Vienna.

I would like to express my gratitude to the Chairperson of the Preparatory Commission for his kind invitation, which has afforded me the opportunity to address this august assembly gathered here to consider the important issues related to nuclear non-proliferation.

I would also like to extend my sincere congratulations to Mr Tibor Tóth, the outgoing Executive Secretary, for his total commitment in the service of world peace and for the excellent work he has accomplished during his two terms of office at the head of our organization.

Promoting the peace and security of humankind is one of the major challenges facing the international community.

The nuclear era, which started in the early 1940s, is characterized by a certain ambivalence. There have been some positive achievements regarding the civilian use of nuclear technology, which has the potential to improve the lives of men and women in the fields of energy and medicine. But on the other hand, it also poses a serious threat to mankind because the military use that can be made of nuclear technology has led to the development and stockpiling of enormous quantities of nuclear weapons and to a stealthy but nonetheless real arms race to acquire and produce these weapons.

Thus, while the risk of a global nuclear war remains contained, the probability of nuclear weapons being used in limited conflicts remains fairly high because of the spread of technology that can be used for nuclear weapons production, the

growing number of political hot-spots in the world and the development of international terrorism.

We are happy to see that the international community has been able to mobilize itself to establish the instruments necessary to address this threat. The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is a key element of the international institutional and legal architecture that the world's States have developed to that end.

Contemporary history of world governance teaches us, on the one hand, that the issue of nuclear non-proliferation in general and the ban on nuclear testing concerns all countries and, on the other hand, that the CTBT is the ultimate legal barrier not only to the development of new weapons but also to the improvement of existing ones.

My country, Burkina Faso, is deeply committed to the promotion of peace and security in our world. It is our conviction that peace and security must be dealt

with in a global fashion in a system based on multilateralism. This is why Burkina Faso has always invested in the initiatives of the international community to prevent conflicts and restore peace in various regions of the world.

Our work has been conducted with success: we have mediated between conflicting parties on the African continent every time the dialogue process between countries has broken down and the population's security has been affected. In the past, we have mediated in Darfur, in Togo, in Côte d'Ivoire and in the Republic of Guinea; today in Mali.

On the subject of nuclear weapons, Burkina Faso was one of the first countries to sign and ratify the treaty that created a nuclear-weapon-free zone in Africa, commonly known as the Treaty of Pelindaba. Burkina Faso is a party to the Nuclear Non-Proliferation Treaty, and is proud to have signed and ratified the CTBT in September 1996 and

April 2002 respectively. This Treaty and its statutory organs require our fullest attention. The CTBT has been waiting on the sidelines for more than 16 years for the international community to affirm its full entry into force by completing the process of signatures and ratifications.

I would like to take this opportunity to add my voice to that of all peace-loving men and women to launch an appeal to all States whose signature and ratification is still needed for the Treaty's entry into force; they should indeed sign and ratify in the name of the promotion of peace and security of humankind.

Despite its relative youth, the CTBT has already been recognized as an international standard, with substantial achievements to its credit. Apart from a few rare exceptions, we can state with satisfaction that traditional nuclear testing has not taken place since the end of the 1990s. We also note that, over and above the issues that are

**»The CTBT is the ultimate legal barrier not only to the development of new weapons but also to the improvement of existing ones.«**

strictly linked to nuclear disarmament and non-proliferation, the data that are collected and the products and technologies developed by the CTBTO and its Preparatory Commission are of great importance in defining effective responses to natural risks and disasters.

The data promote a better knowledge and fuller understanding of geological, climatic and environmental phenomena such as the structure of the Earth's crust, volcanic activity, tsunamis, global climate change and the continual deterioration of ecological balances.

*President Compaoré of Burkina Faso became the first head of state to address the Preparatory Commission for the CTBTO on 13 June 2013.*



*President Compaoré addressing the 40th session of the Preparatory Commission for the CTBTO on 13 June 2013.*





CTBTO Executive Secretary-elect Lassina Zerbo briefing President Compaoré in the Operations Centre at the CTBTO's International Data Centre. June 2013.



President Compaoré (left) and CTBTO Executive Secretary-elect Lassina Zerbo (right) during a press briefing, Vienna, 13 June 2013.



President Compaoré (seated second from left) during his visit to the CTBTO headquarters, Vienna, 13 June 2013. Representing the Permanent Mission of Burkina Faso: Ambassador Paul Tiendrebeogo (to the President's right) and Ambassador Agnekotom Bogore (to the President's left).

I believe that the time has come to strengthen this standard by making the CTBT legally binding and universal. With this expectation, we believe it is necessary to continue to reinforce the technical and operational capacities of the CTBTO because the viability of this instrument of disarmament and non-proliferation depends on the effectiveness of the verification and monitoring regime that underpins it.

You have seen fit to place your trust in Mr Lassina Zerbo to direct the Preparatory Commission of the CTBTO as Executive Secretary. I would like to thank you for this great distinction that you have bestowed on a son of Burkina Faso and of Africa. Your choice reflects your appreciation of the merits of Mr Zerbo, his technical competence acquired throughout his long and very extensive professional career, qualities which are scientific, managerial and diplomatic and which he has deployed in the cause of world peace and security.

Once Mr Zerbo has assumed office, I would like to reiterate my full congratulations, and reassure him of the full backing of the Government and the people of Burkina Faso and convey to him my desire for the complete success of his mission in the service of peace in general and of nuclear non-proliferation in particular.

#### BIOGRAPHICAL NOTE

##### **BLAISE COMPAORE**

is the President of Burkina Faso. He has served as the chairman of various regional bodies, including the Organization of African Unity (now the African Union), the Economic Community of West African States, and the West African Economic and Monetary Union. He has also served as a key mediator in conflicts in Côte d'Ivoire, Togo, Guinea, Mali, Niger and Eritrea/Ethiopia. In recognition of his actions for peace in Africa and the world, he has received several awards, most recently from the Islamic Educational, Scientific and Cultural Organization (ISESCO) in May 2013 and *la Grande Croix de l'Ordre National du Mali* in August 2013.

# AXIVC13

THE 2013 CONFERENCE ON FACILITATING  
THE ENTRY INTO FORCE OF THE CTBT  
**27 SEPTEMBER 2013, UNITED NATIONS, NEW YORK**

## WHAT IS THE ARTICLE XIV CONFERENCE?

- Because of the stringent entry-into-force requirements of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), Article XIV includes provisions for a conference to accelerate the ratification process.
- This ministerial-level conference, also called the Article XIV conference, takes place every two years.
- Special attention is paid to the States defined as nuclear technology capable by the Treaty, known as the Annex 2 States. Eight of these have yet to ratify before the CTBT can enter into force: China, the Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan and the United States.
- As the depositary of the Treaty, UN Secretary-General Ban Ki-moon convenes the conference and invites all stakeholders interested in banning nuclear tests to participate. The majority of States are represented by their foreign ministers. Signatory and non-signatory States, intergovernmental organizations, specialized agencies and non-governmental organizations may also attend.
- This year's conference will take place at the UN headquarters in New York on 27 September. It will be presided over by János Martonyi, Foreign Minister of Hungary, and Marty Natalegawa, Foreign Minister of Indonesia.

## GROUP OF EMINENT PERSONS (GEM)

The CTBT's entry into force is of vital importance for the nuclear disarmament and non-proliferation regime. As of 3 September 2013, the CTBT was approaching universalization with 183 signatures and 159 ratifications. However, 17 years after the Treaty opened for signature it has still not entered into force.

To ensure an innovative and focused approach to advance the CTBT's ratification by the remaining Annex 2 States, a group comprising eminent personalities and internationally recognized experts has been established. Through their experience and political standing, this Group of Eminent Persons (GEM) will support and complement efforts to promote the Treaty's entry into force as well as reinvigorating international endeavours to achieve this goal. The Presidents of the Article XIV conference, the Foreign Ministers of Hungary and Indonesia, who are featured in interviews on pages 8 to 10, will also be members of the GEM.

**Please refer to the separate booklet inside the back cover for an introduction to members of GEM.**



## HUNGARY

# János Martonyi

## Minister of Foreign Affairs of Hungary

*In your capacity as Co-President of the Article XIV conference, what would you consider to be your main priorities in terms of promoting the CTBT's entry into force?*

The inimitable Victor Hugo coined the phrase: "There is nothing more powerful than an idea whose time has come." This is the message I want to convey for the nuclear test ban. Although the CTBT has yet to enter into force, it has come a long way: 183 countries have signed the Treaty and abide by it as if it were global law. Nuclear testing is stigmatized as a pariah activity. But only with the Treaty's entry into force will the chapter of nuclear testing be confined to the history books. We need to make this final push. There is no good reason or excuse for further delay.

*When Hungary ratified the CTBT on 13 July 1999, it became the twentieth of the 44 States that must*

*ratify before the Treaty can enter into force, to do so. Fourteen years later, eight of these countries, known as the Annex 2 States, have still not ratified the CTBT: China, the Democratic People's Republic of Korea (DPRK), Egypt, India, Iran, Israel, Pakistan and the United States. Over the next two years, how will you encourage these countries to sign and/or ratify the CTBT?*

Of course every country needs to convince itself that the CTBT serves its own security interests. But to arrive at this conclusion, we need to initiate an open and frank reflection process in each country, involving decision-makers at the highest level. In our interaction with the outstanding countries, Indonesian Foreign Minister Marty Natalegawa and I will strongly encourage such a reflection process, in which the CTBT should be considered on its own merits: "Is my country's

**»The CTBTO's monitoring stations can detect suspicious events with remarkable speed, certainty and precision, as the network has shown in the case of all three North Korean nuclear tests.«**

security best served if all countries are bound by the test ban, or is it preferable to keep the option for future testing open – at the price of a free-for-all for the entire world?"

And why not consider questions of status and prestige, which play a greater role than often admitted in these

issues: "Is my country's status served by remaining a CTBT holdout forever? Could conducting nuclear tests enhance my country's prestige?" In my view, the case of North Korea, the only country to have conducted nuclear tests this century, provides a clear-cut answer.

Another important argument we will make is that without the CTBT's entry into force, the international community deprives itself of a powerful verification measure, that of on-site inspections. The CTBTO's monitoring stations can detect suspicious events with remarkable speed, certainty and precision, as the network has shown in the case of all three North Korean nuclear tests. However, in cases of uncertainty, only an on-site inspection can provide clarity as to whether a nuclear explosion has actually taken place. Hungary is proud to have contributed to the CTBTO's on-site inspection capabilities by recently hosting another on-site inspection exercise.

*All European countries have ratified the Treaty. Why is this important and what special role can Europe play in promoting the Treaty's entry into force?*

Not only have all European countries ratified the CTBT, but they have supported the aims of the Treaty in every other way possible. We have lobbied hard for entry into force since the very beginning; nearly every CTBTO monitoring station hosted by European countries is sending data; the Member States of the European Union contribute around 40 percent of the organization's budget and have provided over €15 million in voluntary contributions. The most recent contribution was initiated under Hungarian EU presidency. And with regard to my country, we are of course proud that a Hungarian, Ambassador Tibor Tóth, steered the organization so competently through the sometimes choppy waters over the past eight years, from August 2005 to July 2013.

So Europe has a special moral authority to promote the Treaty. Like Hungary, many European countries are

**»Given the importance of its nuclear arsenal, I believe that the United States has a certain moral obligation to lead the way, as recognized by President Barack Obama's announced intention to pursue CTBT ratification. We hope that the required majority in the U.S. Senate can be achieved.«**

also members of NATO, which has placed increasing emphasis on arms control, disarmament and non-proliferation as a means to promote security. When Hungary hosted the 2012 NATO Conference on Weapons of Mass Destruction Arms Control, Disarmament and Non-Proliferation, I highlighted the CTBTO's role in this context. As NATO Members, we have an important case to make vis-à-vis our large transatlantic NATO partner: the firm belief that ratification by the United States is in no way detrimental to NATO's nuclear deterrent, but that it would, on the contrary, enhance global security.

*What effect do you consider ratification by the United States will have on the remaining Annex 2 States?*

Given the importance of its nuclear arsenal, I believe that the United States has a certain moral obligation to lead the way, as recognized by President Barack Obama's announced intention to pursue CTBT ratification. We hope that the required majority in the U.S. Senate can be achieved. The other seven countries should not remain idle either. It is time to move forward now.

*In addition to strengthening the non-proliferation and disarmament regime, countries reap a multitude of other membership benefits by adhering to the CTBT such as access to verification data and the possibility of participating in capacity building activities. How can countries that have not yet signed the*

*Treaty best be made aware of the advantages of joining the 183 countries that are already enjoying these benefits?*

These countries have to be made aware of the extent to which they are depriving themselves of the opportunities that the 16 gigabytes per day of CTBTO data offer. These include chances for scientific development, human welfare and disaster warning. Marty Natalegawa and I will be sure to emphasize this aspect. India and Pakistan, for example, are regularly affected by tsunamis, earthquakes and storms. Both countries are expanding their nuclear industries. In the unfortunate event of a serious nuclear accident occurring in this densely populated region, CTBTO data could be critical for warning populations of airborne radioactivity.

#### BIOGRAPHICAL NOTE

##### JÁNOS MARTONYI

was appointed Minister of Foreign Affairs of Hungary in 2010, a position which he also held from 1998 to 2002. Between 1994-1998, as well as 2002-2009 he was Managing Partner of Martonyi and Kajtár, Baker & McKenzie Law Firm in Hungary. Prior to this he held a number of political posts including Administrative State Secretary at the Ministry of Foreign Affairs from 1991 to 1994 and at the Ministry for International Economic Relations from 1990 to 1991. He is a professor of International Trade Law at the University of Szeged.



## INDONESIA

# Marty M. Natalegawa

## Minister of Foreign Affairs of Indonesia

**»If the remaining Annex 2 States are committed to building a safe world for the next generation, ratification by any one of them will move the Treaty one step closer to entry into force.«**

*In your capacity as Co-President of the Article XIV conference, what would you consider to be your main priorities in terms of promoting the CTBT's entry into force?*

It is clear that nuclear disarmament is one of the most urgent global challenges. In this regard, one of my priorities in my capacity as Co-President of the eighth Article XIV conference will be to ensure that CTBT ratification remains a prominent issue on the international agenda. I will work closely with my counterpart from Hungary to make this a reality by promoting and coordinating

outreach activities for the Treaty at the highest possible level, at international forums, regional conferences and bilateral meetings, and I will invite other like-minded States to do the same. Further collaboration with intergovernmental and non-governmental organizations to raise awareness of and strengthen support for the Treaty and its objectives is also one of the priorities.

At the Article XIV conference, we will need to determine additional concrete measures to accelerate the Treaty's entry into force and promote

its universalization process. These measures will include further encouraging the remaining Annex 2 States – China, the Democratic People's Republic of Korea (DPRK), Egypt, India, Iran, Israel, Pakistan and the United States – to sign and ratify the Treaty, as shown by Indonesia's ratification in 2012. They need to demonstrate leadership by taking the initiative rather than waiting for others to act first. Ratification by all of the Annex 2 States will enable the Treaty to enter into force, which will create tremendous momentum for the achievement of our shared vision of a nuclear-weapon-free world.

To promote the CTBT, we should also promote closer cooperation between the Preparatory Commission for the CTBTO and nuclear-weapon-free zones, as they have complementary objectives.

*When Indonesia completed its ratification process of the CTBT on 6 February 2012, it was a highly symbolic move. It moved the Treaty one step closer to universalization by reducing the number of countries to eight that must ratify the Treaty before it can enter into force. Over the next two years, how will you encourage the remaining Annex 2 States to sign and/or ratify the CTBT?*

I will encourage them to follow Indonesia's example and ratify the CTBT. Such a move will strengthen their position and influence as countries that support nuclear disarmament and it would help achieve a more secure global environment. We are extremely concerned that although the Cold War ended over two decades ago, the world is still far from becoming a safer place as nuclear weapon States retain their nuclear arms. We are deeply concerned that certain countries such as the DPRK have conducted nuclear weapon test explosions, exacerbating tensions in the region. Such nuclear tests highlight the urgent need for the CTBT's entry into force.

If the remaining Annex 2 States are committed to building a safe world for the next generation, ratification by any one of them will move the Treaty one step closer to entry into force. This will immediately boost efforts by the international community to prevent States from acquiring, developing and proliferating nuclear weapons. The cessation of nuclear weapons testing will be a milestone to achieve a nuclear-weapon-free world.

*Several of the remaining Annex 2 States, such as China, the DPRK, India and Pakistan, are in Asia. Why is it important for these countries to sign and/or ratify the CTBT and what leadership role can they play in this regard?*

Their ratification would not only reduce regional tensions and bolster security in the region, but would also strengthen the global ban against nuclear testing, thus enhancing their leadership role both at the regional and international levels in the area of nuclear disarmament and non-proliferation.

*In Southeast Asia, Thailand and Myanmar signed the CTBT on 12 November 1996 and 25 November 1996 respectively but they have not yet ratified. In your opinion, what is the most effective way to convince them that ratification is in their interests?*

It would be natural for both Thailand and Myanmar to ratify the CTBT since they recognize that the way to achieve lasting international peace and security

is to support nuclear disarmament and non-proliferation. These are central themes to the security of the Association of Southeast Asian Nations (ASEAN).

Brunei Darussalam ratified the CTBT on 10 January 2013, meaning that Thailand and Myanmar are the only ASEAN countries that have not yet done so. Since the 10 Member States of ASEAN also form the Southeast Asia Nuclear-Weapons-Free Zone (SEANWFZ), we fully believe that CTBT ratification by Thailand and Myanmar would reinforce the goals of the SEANWFZ or Bangkok Treaty.

I note that for Thailand, the issue is not about the lack of political will. Rather, in accordance with its legal system, Thailand should ensure that the necessary implementation legislation is in place before ratifying the Treaty. I have confidence that similar progress would be made in Myanmar's ratification of the CTBT in the near future. For these reasons, we should work with all ASEAN countries to encourage the implementation and universalization of the CTBT in the region.

*In addition to strengthening the non-proliferation and disarmament regime, countries reap a multitude of other membership benefits by adhering to the CTBT. These include access to verification data, which also offer a range of civil and scientific applications, and the possibility of participating in capacity building activities. How can countries that have not signed the Treaty yet be best made aware of the advantages of joining the 183 countries that are already enjoying these benefits?*

Non-signatories could be targeted through outreach activities that highlight the membership benefits, especially in terms of disaster mitigation, such as the use of CTBT monitoring data for tsunami early warning purposes or for tracking radioactivity in the case of a nuclear accident.

My own country suffered greatly from the 2004 Indian Ocean tsunami, as

**»We are deeply concerned that certain countries such as the DPRK have conducted nuclear weapon test explosions, exacerbating tensions in the region. Such nuclear tests highlight the urgent need for the CTBT's entry into force.«**

did a number of other countries including India – one of the non-signatory States. Since that catastrophe, the CTBTO has been sharing monitoring data with tsunami warning centres in Indonesia and with several other countries in different regions of the world. The data increase their ability to issue more rapid warnings. India and other countries that have not yet signed the Treaty could receive benefits by becoming signatories and entering into a tsunami warning agreement with the CTBTO.

I will urge CTBTO Member States to take advantage of relevant regional conferences to inform non-signatories that by joining the CTBT, their nationals will also be able to participate in workshops, seminars and training activities where they can learn about the potential civil and scientific uses of verification data and technologies.

#### BIOGRAPHICAL NOTE

##### MARTY M. NATALEGAWA

was appointed Foreign Minister of the Republic of Indonesia in 2009. He played a key role in Indonesia's ratification of the CTBT in 2012. Prior to this, he served as the Permanent Representative of Indonesia to the UN in New York from 2007 to 2009 and as the Ambassador to the United Kingdom from 2005 to 2007. He served consecutively as Chief of Staff of the Office of the Minister for Foreign Affairs and as the Deputy Minister for ASEAN Cooperation from 2002 to 2005.



Photo courtesy of Kristinn Ingvarsson

## VOICES

# The CTBT: Helping to make the world a safer place

BY GUNNAR BRAGI SVEINSSON  
MINISTER FOR FOREIGN AFFAIRS  
AND EXTERNAL TRADE OF ICELAND

enter into force. It is therefore deeply disappointing that some Annex 2 States have not even signed the Treaty and others, who are signatories, have not concluded ratification.

Located halfway between Washington and Moscow, Reykjavík, the capital of Iceland, played host to the summit between U.S. President Ronald Reagan and Soviet General Secretary Mikhail Gorbachev in October 1986. The leaders discussed the reduction of nuclear weapons and even raised the possibility of their elimination. Ultimately, no commitments were made. Nevertheless, the summit has been described as one of the most dramatic and potentially productive summits in the history of nuclear disarmament. It also turned out to be of great significance for global peace and security as well as for future disarmament and arms control measures. Based on the momentum gained in Reykjavík, a year later the United States and the Soviet Union signed the Intermediate Range Nuclear Forces Treaty, for the first time eliminating an entire class of nuclear weapons. In 1991 the two States signed the Strategic Arms Reduction Treaty, and in 1996 the Comprehensive Nuclear-Test-Ban Treaty (CTBT) was opened for signature.

### HALTING AND REVERSING THE DEPENDENCY ON WEAPONS OF MASS DESTRUCTION

Iceland has a long record of commitment and integrity on nuclear issues. It is also a strong supporter of the CTBT, having signed it on 24 September 1996 and ratified it on 26 June 2000. Nuclear testing has been regarded as the engine of nuclear proliferation. It is imperative that the CTBT enters into force to halt and reverse the dependency on weapons of mass destruction. Furthermore, it is abundantly clear that all non-proliferation efforts are critical in tackling the threat of terrorists acquiring nuclear weapons. A fully ratified and implemented CTBT is an indispensable building block for these efforts.

In spite of strong global aspirations, manifested in 183 signatures and 159 ratifications, this important Treaty has not yet entered into force. Without the signature and ratification of all the 44 states listed in its Annex 2, the CTBT cannot

### THE INTERNATIONAL MONITORING SYSTEM: HELPING ENHANCE INTERNATIONAL SECURITY

One of the main aims of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is to develop the International Monitoring System (IMS) based on a network of 337 monitoring stations. These facilities help enhance international security by monitoring the globe for evidence of a nuclear explosion and must all be in place when the Treaty enters into force. Over 85% of the IMS stations worldwide are already fully operational and transmitting data to the International Data Centre (IDC) in Vienna.

Iceland supports the CTBTO by contributing to the IMS with an auxiliary seismic station in Borgarnes, on the west coast of Iceland (AS38), and a radionuclide station in Reykjavík (RN34). AS38 was one of the IMS seismic stations that detected signals from the nuclear test carried out by the

Democratic People's Republic of Korea on 12 February 2013, and sent data to the IDC in Vienna for analysis.

### HELPING MITIGATE THE EFFECTS OF NATURAL OR MAN-MADE DISASTERS

While the CTBT's primary purpose is to ensure that no nuclear test goes undetected, data generated by stations can also help mitigate the effects of natural or man-made disasters. On 22 March 2011, RN34 became the first IMS radionuclide station in Europe to detect iodine-131 originating from the accident at the Fukushima Daiichi nuclear power plant 11 days earlier. Tests by scientists from the Icelandic Radiation Safety Authority (IRSA) showed that the radioactivity posed absolutely no risk to public health. This played an important role in alleviating concerns in Europe. The IRSA concluded that CTBTO data can serve as a powerful tool for analyzing the global distribution of radionuclides from a nuclear accident.

IMS seismic and hydroacoustic stations can also detect earthquakes that can cause tsunamis. The CTBTO provides the data in near real-time to tsunami warning centres, particularly those covering the Pacific and Indian Oceans, to help them issue more timely and precise warnings. Ten tsunami warning centres in high-risk areas currently receive data from around 60 CTBTO stations. When the 8.9 magnitude earthquake struck the north-east coast of Japan on 11 March 2011, triggering a massive tsunami that also caused the accident at Fukushima, CTBTO data helped Japanese authorities issue timely tsunami warnings. The data from about 20 seismic and hydroacoustic stations were sent directly and in real time to seven warning centres in the region, including Japan and the United States.

### MONITORING VOLCANIC ACTIVITY

The potential use of CTBTO data to monitor volcanic eruptions is of great interest to Iceland. The volcanic activity in our country is well known and caused major disruptions to air traffic across Europe during the eruption of



Technical Training Course for Radionuclide Station Operators, Reykjavik, Iceland, 5-9 August 2013. Photo courtesy of Guillaume Beziat

Eyjafjallajökull in April 2010. Data from the CTBTO's seismic stations can, for example, indicate that a volcanic eruption is imminent and infrasound stations can monitor volcanic activity by registering the very low frequency sound waves that eruptions emit.

On-site inspections (OSI) are the final verification measure to establish whether or not a nuclear explosion has taken place. The CTBTO routinely convenes workshops, training and exercises to develop its OSI operational capabilities. The CTBTO concluded its first integrated field exercise in Kazakhstan in 2008 and is currently preparing for another one in Jordan next year.

### A RANGE OF CAPACITY BUILDING OPPORTUNITIES

In addition to the obvious political benefits and the civil and scientific applications of the monitoring data, CTBTO membership offers capacity building opportunities. Every year hundreds of technical experts who are engaged in test-ban verification acquire pertinent skills to keep them abreast of the latest developments in verification technologies. Iceland actively participates in these activities and organized Technical Training Programme Courses for Radionuclide Station Operators in Reykjavik in October 2009 and August 2013, in collaboration with the CTBTO.

The courses provided station operators with the basic knowledge and technical understanding necessary for the operation, maintenance and management of an IMS station using radionuclide technology. Iceland is proud of these contributions to the activities of the CTBTO.

What may have been a distant dream at the 1986 Reykjavik summit has become a realistic working goal. Previous champions of nuclear weapons have become advocates of non-proliferation and are calling for the entry into force of the CTBT. We have a responsibility to future generations to make the world a safer place by eliminating the threat of nuclear destruction. By banning all nuclear explosions, the CTBT in force will move the world one step closer to making this dream a reality.

#### BIOGRAPHICAL NOTE

##### GUNNAR BRAGI SVEINSSON

has been the Minister for Foreign Affairs and External Trade of Iceland since May 2013. He has been a Member of the Althingi, the Icelandic Parliament, since May 2009. He was also the Chairman of the parliamentary group of the Progressive Party between 2009 and 2013. Prior to this he held various positions on behalf of local municipalities, also working in commerce and marketing and as a managing director, the editor of a district newspaper, and the political advisor to the Minister of Social Affairs.



**HANS BLIX**  
 FORMER DIRECTOR GENERAL  
 OF THE INTERNATIONAL  
 ATOMIC ENERGY AGENCY

I can think of no treaty in which the assistance of the scientific community has been greater than the CTBT. Through patient, skilful and arduous work a crucially important monitoring system was designed relying on seismic, hydroacoustic, infrasound and radiation sensors all around the world. The system does not raise questions of reliability. Rather, the success of the system raises the question whether the scientific community can again be engaged to help disarmament, for instance solving problems around the verification.

As is well known, the CTBTO and the monitoring system provide even now practically useful services on a daily basis. The CTBT, one might say, is the rare case of a treaty that has entered into operation before it has entered into force! However, even though there is little risk of a breach of the moratorium on tests that is being observed by all except North Korea, the risk would be further reduced by a formal entry into force. The greatest help to achieve this would be support by those in the U.S. Senate who have so far prevented U.S. ratification to keep open a U.S. option to test. However, keeping the legal option open for the U.S. is keeping it open for all. I am not suggesting that U.S. ratification would automatically trigger all the other ratifications, but I am sure it would go a long way.



**ELLEN TAUSCHER**  
 FORMER U.S. UNDER SECRETARY  
 OF STATE FOR ARMS CONTROL AND  
 INTERNATIONAL SECURITY

The National Academy of Sciences (NAS), a trusted and unbiased voice on scientific issues, released an unclassified report in 2012 examining the treaty from a technical perspective. The report looked at how the United States' ratification would impact our ability to maintain our nuclear arsenal and our ability to detect and verify explosive nuclear tests. The NAS report concluded that, without nuclear tests, "the United States is now better able to maintain a safe and effective nuclear stockpile and to monitor clandestine nuclear-explosion testing than at any time in the past."

Moving forward on the CTBT will be tough. No doubt. I recognize that a Senate debate over ratification will be spirited, vigorous and likely contentious. The debate in 1999 unfortunately was too short and too politicized. The treaty was brought to the floor without the benefit of extensive committee hearings or

## SCIENCE AND TECHNOLOGY 2013 KEYNOTE SPEAKERS

The main aims of the Conference were to advance the verification of the CTBT and to strengthen the CTBTO's relationship with the broader scientific community. Excerpts from the keynote addresses during the opening and closing sessions are featured below. The full addresses and more information about the conference are available on our website: [www.ctbto.org](http://www.ctbto.org)

significant input from administration officials and outside experts. We will not repeat those mistakes.

Just as we did with New START, the Obama administration can and should make a more forceful case when it is certain the facts have been carefully examined and reviewed in a thoughtful process. I know that Rose Gottemoeller is committed to taking a bipartisan and fact-based approach with the Senate.

For my Republican friends who voted against the treaty in 1999 and might feel bound by that vote, I have one message: Don't be. The times have changed.

As my good friend and fellow Californian, George Shultz, likes to say and repeated this year— those who opposed the treaty in 1999 can say they were right. But they would be more right to vote for the treaty today.



Hans Blix (left), Ellen Tauscher (centre) and Siegfried Hecker (right) during a panel discussion at the Science and Technology 2013 Conference.



**SIEGFRIED HECKER**  
FORMER DIRECTOR OF  
THE LOS ALAMOS  
NATIONAL LABORATORY

What are the benefits of CTBT ratification and the treaty entering into force? The CTBT constrains nuclear weapons development although that is less important for the United States or Russia with 1,054 and 715 tests [respectively] and applies more to countries that have conducted fewer tests. It constrains the sophistication of nuclear arsenals: North Korea is a case in point. The CTBT is consistent with Article VI of the Nuclear Non-Proliferation Treaty and the eventual elimination of nuclear weapons. It supports the whole non-proliferation regime. And even though the health and ecological effects are much less now than they were during the atmospheric testing era, there is of course still that concern... A return to testing would increase the risk of an arms race and a nuclear confrontation. That's what we have to keep in mind today... In today's security and political environments, the benefits of not testing therefore significantly outweigh the risks.

The international community must, in my opinion, increase the barriers to the resumption of testing and one of the most important barriers is indeed ratification by the United States and the entry into force of the CTBT. But that's not enough. It's also essential to create the security conditions that convince countries to refrain from testing or to refrain from developing nuclear weapons in the first place.



**MICHEL MIRAILLET**  
DIRECTOR OF  
STRATEGIC AFFAIRS,  
FRENCH MINISTRY OF DEFENSE

Today the CTBTO delivers almost the best of what is possible in terms of verification. ... We should not forget that all the events in North Korea in 2006, 2009 and 2013, despite low-energy levels, were detected, localized and identified, [allowing] Member States to exercise their verification capabilities in order to define whether these events were nuclear tests or not... The CTBTO is today providing what is at the heart of the Treaty: ensuring that no nuclear test would go unnoticed worldwide. And today, no one can reasonably challenge the technical capacity of the CTBTO to maintain this level of performance that already fits the needs...

I must commend the scientists: the older generation who placed the keystones that established the principles of the verification system, and the younger

COMPREHENSIVE  
NUCLEAR-TEST-BAN TREATY:  
SCIENCE AND  
TECHNOLOGY  
2013 CONFERENCE  
17-21 JUNE 2013  
HOFBURG, VIENNA

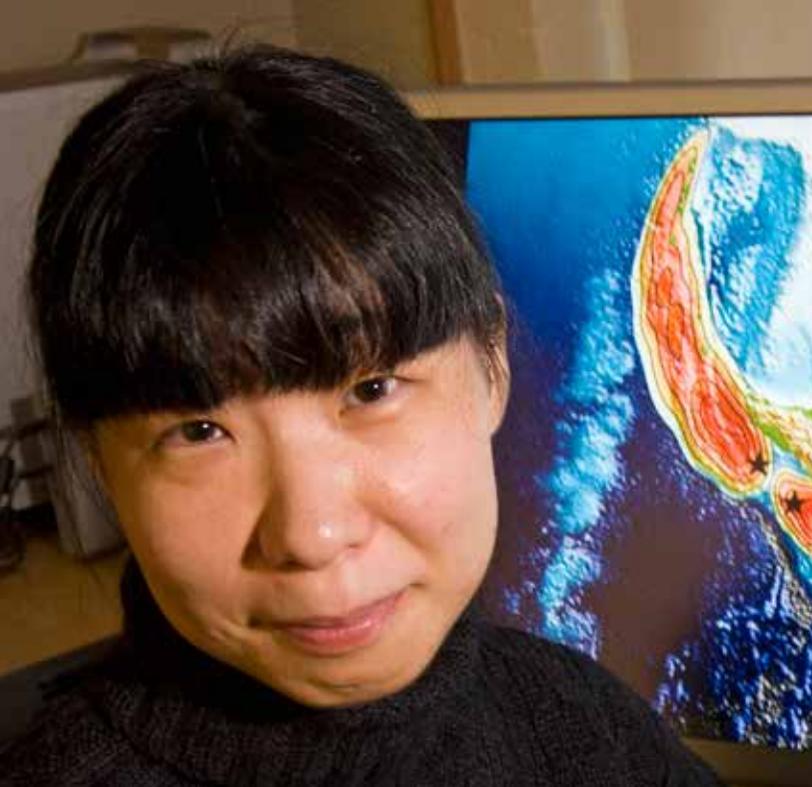
WITH THE GENEROUS SUPPORT OF THE REPUBLIC OF AUSTRIA Federal Ministry for European and International Affairs

ones who today stimulate reflection on the future of the system... Verification technologies are attractive from a scientific perspective... the performance of the system will continue to improve... The decision makers are interested in the results, and should provide funds to support innovative research and development in these areas...

In fifteen years the CTBTO, through the contributions of Member States, spent a little more than one billion U.S. dollars. If we now look at the other benefits provided directly by the system (tsunami warnings, earthquakes surveillance, radionuclide monitoring, etc.) and less directly (education, science, engineering, etc.) there is no doubt here again that benefits for the States are much higher than costs.



Michel Miraillet (left), Patricia Lewis, Research Director at Chatham House (centre) and Siegfried Hecker (right) on the final day of the Science and Technology 2013 Conference.



## VERIFICATION SCIENCE

# Looking into the Earth with CTBT seismic sensors

BY MIAKI ISHII  
DEPARTMENT OF EARTH AND PLANETARY SCIENCES, HARVARD UNIVERSITY, USA

On 12 February 2013, the seismic component of the CTBTO network once again demonstrated its ability to detect nuclear tests – for the third time since 2006. At 02.57.51 (UTC), an event measuring 4.9 in magnitude was picked up by no less than 94 CTBTO seismic stations. Member States received the first estimates of location, depth, time and magnitude in little more than an hour, and before North Korea had announced that it had conducted its third nuclear test.

### SEISMIC SIGNALS CARRY A WEALTH OF INFORMATION

It is less known to the public that in addition to providing information about the event in North Korea, the seismic signals detected that morning actually carried plenty of other information. As seismic waves from any event travel through the Earth, their path is not confined to the crust. They may also run through the Earth's mantle. Or they might traverse the Earth's core, skim it or be reflected by it. In doing so, these waves tell us not only about the nuclear test, but also about the Earth's internal structures that they passed through on their way to the seismometer.

The principle is the same as that used by doctors to study the inside of the human body in non-invasive ways, for example, when using medical

ultrasound or X-rays. The difference is only that for "looking" into the Earth, the seismic waves generated by earthquakes or nuclear explosions replace ultrasound or X-rays, and the seismic sensors are the detectors. In fact, they are our most important means of studying the Earth's interior, as the deepest hole ever drilled reached down to 12.2 kilometres (7.6 miles), piercing less than 0.2% of the Earth's radius.

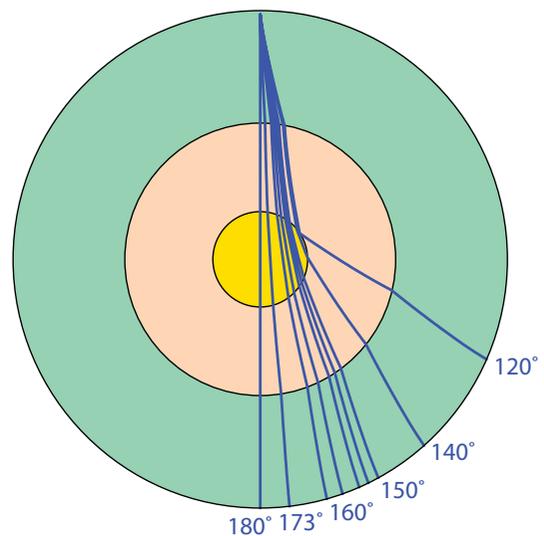
### POWERFUL TELESCOPES THAT CAN VIEW INSIDE THE EARTH

Even though investigating the Earth's subsurface is not the main objective of the CTBTO's seismic network, its

stations serve unexpectedly well as powerful telescopes to view inside the Earth. Showcasing spin-off effects like this was one of the themes a symposium on "The unreasonable usefulness of test-ban verification for disaster warning and science". I participated in this symposium on 17 February at the annual meeting of the American Association for the Advancement of Science in Boston, United States.

Other purely scientific seismic networks can be used to that effect as well. However, in order to study how seismic waves travel through the Earth's core, a seismic station needs to be located on the far side of the Earth.

*Seismic waves may traverse the Earth's core, skim it or be reflected by it.*



As earthquakes occur in many parts of the world along tectonic plate borders, there is a fair chance that at least one of the CTBTO's 170 seismic stations will be suitable. Combined with their high level of data availability, this makes the stations interesting for Earth scientists.

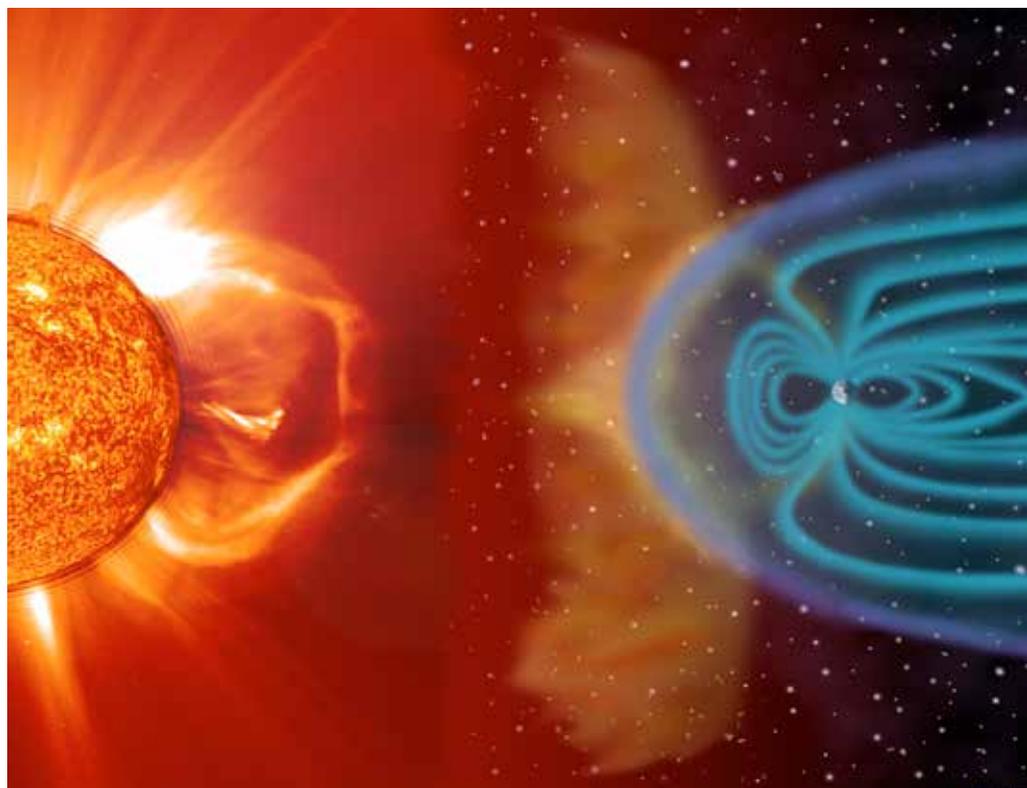
### UNDERSTANDING THE INTERNAL STRUCTURE OF THE EARTH

The seismic data show us the Earth's interior from just beneath our feet to all the way down to the centre of the planet, at around 6,400 km (almost 4,000 miles) below the surface. A detailed knowledge of the internal structure is essential to unravel the dynamics and history of the Earth. For example, just as there are continents and oceans, there are regions of fast and slow seismic wave speeds within the Earth's mantle. Such structure is thought to be related to mantle convection, which drives plate tectonics and hence dynamic processes at the surface such as where earthquakes and volcanoes occur.

Diving even deeper, the Earth's core, which is more than 3,200 km (over 2,000 miles) deep, is divided into a liquid outer core and a solid inner core. CTBTO data, for example, can inform us about the properties of the transition from the outer to the inner core. This boundary is important for the operation of vigorous mixing within the outer core that generates the Earth's magnetic field, which shields us from harmful cosmic rays and helps us navigate.

### IDENTIFYING THE COMPOSITION OF THE EARTH'S CORE

The way in which seismic waves are influenced when passing through the Earth's interior structures also helps to reveal their composition. The phenomenon that wave speeds differ according to the travel direction is known as anisotropy (as opposed to isotropy, where the wave speed is the same for all directions). Significant seismic anisotropy has been detected in the Earth's inner core, suggesting that crystals that make up the inner core are not randomly



*The Earth's vital magnetic field is generated within the Earth's outer core. Photo courtesy of NASA.*

gathered together. Such information, combined with data from other fields of Earth Sciences (e.g., geochemistry), shows that the Earth's core is made up mostly of iron with some impurities such as silicon and oxygen. This metallic core composition differs significantly from the mantle that consists mainly of rocks.

So while the scientific value of the seismic probe into the Earth's interior is enormous, a better understanding of the underground structure, in turn, ultimately improves the identification and characterization of nuclear explosions. This is because the distortion in the seismic waves caused by the underground structure can be properly accounted for, rather than being accepted as uncertainties in nuclear explosion detection.

### IMPROVING THE SCIENTIFIC UNDERSTANDING AND FUTURE OF OUR PLANET

For certain regions of the world, the CTBTO has recently started, in cooperation with some of its Member States, to factor in such structural particularities on a regional basis.

Using the U.S. Regional Seismic Travel Time software and model, seismic travel times have been mapped in three dimensions for North America and Eurasia, allowing for a more accurate location of seismic events. Modelling is under way for Africa, Central and South America, South East Asia and Australia. The investigations of the Earth's internal complexities and event determination go hand in hand in improving both the scientific understanding and future of our planet.

### BIOGRAPHICAL NOTE

#### MIAKI ISHII

has been an Associate Professor of Earth and Planetary Sciences at Harvard University since 2010. Her main research interest is the use of seismic energy recordings to image the internal structure of the Earth and to study properties of earthquakes. She has won a number of awards and honours including the Charles F. Richter Award from the Seismological Society of America and the James B. Macelwane Medal from the American Geophysical Union.



## VERIFICATION SCIENCE

# Joining forces to reduce radioxenon emissions

While monitoring the globe for signs of a nuclear explosion, experts at the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) frequently detect radioxenon – a radioactive form of the chemical element xenon.

Since radioxenon isotopes are produced in large quantities during fission in a nuclear explosion, they play a major role in confirming whether or not an underground explosion was nuclear in nature.

### XENON EMISSIONS FROM A SURPRISING SOURCE

Many people assume that the main sources of this noble gas are the 400-plus nuclear power reactors around the world that produce electricity. However, this is not the case: nuclear plants emit only small quantities of xenon because they have effective retention systems. In 2002 monitoring scientists from Health Canada discovered an unlikely source – facilities that produce life-saving medicines. The isotopes produced by these facilities play an important role in diagnostics, for example, and are used in nuclear medicine worldwide

for more than 30 million diagnostic procedures a year. Production facilities are operated in about 10 countries today, with most producers in Europe, North America and Australia. Radioisotopes in healthcare are in high demand, especially an element called technetium-99m.

"Medical isotopes must be produced continually and used efficiently in order to meet demands. The medical isotope production facility in Serpong in western Java, Indonesia – Pt. BATAN Teknologi – serves 16 hospitals in Indonesia," explained Yudiutomo Imardjoko, the facility's Chief Executive Officer. "We also export to medical centres in Bangladesh, Thailand, Malaysia and Vietnam. We are planning to expand exports of medical isotopes to India and Japan. The growth rate of medical isotope production in Asia is about 10% per year so we need to increase our production because Pt. BATAN Teknologi is the only producer in the region."

For the CTBTO, it is of great importance to understand the sources of environmental radioxenon to be able to distinguish civil sources from those of a nuclear explosion. The CTBTO's global

network of stations – the International Monitoring System (IMS) – will comprise 337 facilities when complete, including 40 radionuclide stations capable of detecting radioxenon. Thirty-one of these radionuclide stations are already equipped with noble gas capabilities.

### HIGH STAKE CHALLENGES

While medical sources of radioxenon do not pose any health risk, they are a cause for concern because the readings from these emissions resemble those of a nuclear explosion.

At a large scientific conference organized in Vienna in June 2013, the *CTBT: Science and Technology 2013 Conference*, a special panel was dedicated to the issue of emissions by radiopharmaceutical plants. CTBTO radionuclide expert Mika Nikkinen explained that the impact on IMS stations varies greatly, with up to 400 detections per year at one station and only a single one at others.

At the CTBTO's headquarters in Vienna, analysts scrutinize about 18,000 samples of xenon a year, which are registered by IMS stations

Medical isotopes play an important role in medicine, for example in diagnostics.

around the world. Multiple civil sources of radioxenon that can mask signals from a nuclear explosion mean that stakes are high.

Even small quantities of xenon can affect the reliable detection of nuclear explosions. In order to address this challenge, the CTBTO is collaborating with scientists and medical isotope producers in an attempt to improve xenon monitoring and reduce emissions. Producers are exploring different methods to achieve reductions. Joint work seeks to establish a voluntary threshold for xenon emissions, and to improve scientific understanding of background levels in the air.

### MONITORING AT THE SOURCE

"As the production of medical isotopes increases, so does the prospect of radioxenon emissions into the environment, which is why we agreed to take part in a background radioactive xenon measurement campaign," said Yudiutomo Imardjoko. "In October 2012, a stack monitoring system was installed at the Serpong facility with the support of the CTBTO and the United States. By

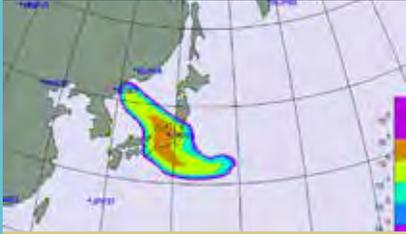
monitoring radioxenon that is released into the environment, this system plays a key role in controlling emissions in an industrial setting. As it stands right now, the maximum xenon release should not exceed  $5 \times 10^9$  Becquerel (Bq) per day (Recommendation from the Workshop on Signatures of Medical and Industrial Isotope Production, Strassoldo, Italy, July 2012). Radioxenon releases from PT. Batan Teknologi are nowhere near as high as that figure."

### UNDERSTANDING XENON BACKGROUND LEVELS

Through joint campaigns in Japan, Kuwait, Indonesia and other countries, and with the support of the European Union (EU), advanced automated detection systems have been established to measure noble gases in more places, thus providing evidence of the background levels of radioxenon in the atmosphere.

In Jakarta, Indonesia, a system to measure noble gases has been set up at the BATAN Center for Technology, Metrology and Safety. This customized

**NORTH KOREA'S 2013 ANNOUNCED NUCLEAR TEST**



When the CTBTO's radionuclide station in Takasaki, Japan, detected two radioactive isotopes of the noble gas xenon almost two months after North Korea announced that it had conducted a nuclear test on 12 February 2013, CTBTO experts worked closely with national authorities to eliminate the hypothesis of other radioxenon sources in the region. The ratio of the isotopes was found to be consistent with a nuclear fission event occurring more than 50 days before the detection. CTBTO experts also used a technique called Atmospheric Transport Modelling (ATM) to backtrack the travel paths of the radioxenon; ATM calculations indicated that the North Korean test site was a possible source for the emission.

transportable xenon lab is known as the TXL. The unit can be up and running within days after delivery. According to Susilo Widodo, Director of



Inside Indonesia's Serpong medical isotope production facility.



CTBTO Executive Secretary-elect Lassina Zerbo (left) and Jean-Michel Vanderhofstadt, Manager Director, Institute for Radioelements, signing a pledge to cooperate to mitigate the effects of radioxenon emissions in Vienna, Austria, on 20 June 2013.

the Center for Technology of Radiation Safety and Metrology at BATAN, the system now operates continuously every day and data are sent routinely to the International Data Centre in Vienna for evaluation. As Ted Bowyer, Program Manager Nuclear Explosion Monitoring, Pacific Northwest National Laboratory, USA, explained, the TXL has been used in collaboration with local partners and also with the CTBTO to make measurements in locations across the world.

#### MITIGATING THE EFFECTS OF NOBLE GAS EMISSIONS

In an important development in June 2013, the Belgium-based Institute for Radioelements (IRE) signed a pledge to cooperate with the CTBTO to mitigate the effects of noble gas emissions. The IRE is a major worldwide producer of radioelements used for diagnoses and therapeutics in nuclear medicine.

Through its voluntary contributions, the EU supports the development of the mitigation systems that will be used by the IRE. At the *CTBT: Science and Technology 2013 Conference*, the EU also sponsored the "EU Star Award for best presentation on a verification topic," which was awarded to Johan Camps from the Belgian Nuclear Research Centre (SCK · CEN) for his work to test radioxenon mitigation methods at the IRE.

#### SUSTAINABLE GLOBAL COLLABORATION

Ultimately, cooperation helps achieve bigger goals. "Our prime responsibility is verifying the CTBT. It's all about collaboration because we have to put everything in the context of helping the International Monitoring System to assist the verification of the Treaty. When people see there's collaboration, I think it can only

**»We are pleased to cooperate on mitigating xenon emissions with the CTBTO, while keeping our focus on health care for the around 6 million patients who receive our products each year.«**

**JEAN-MICHEL VANDERHOFSTADT,**  
MANAGING DIRECTOR, INSTITUTE FOR  
RADIOELEMENTS

help for trust-building," says the CTBTO's Executive Secretary Lassina Zerbo. "The noble gas background measurement is an important factor. It is one of the important measures that gives the nuclear nature of a test."



# Build-Up Exercise III

## Preparing for the next OSI Integrated Field Exercise (IFE14) in Jordan

Upon entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), an on-site inspection (OSI), will be the final, Treaty-specified verification measure to determine whether or not a nuclear explosion has been conducted in a suspected area. In preparation for entry into force, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) conducts regular simulations and training exercises to fine-tune its procedures and processes.

From 26 May to 7 June 2013, nearly 150 experts from 40 countries

gathered at a military training ground near Veszprém, Hungary, for a simulated search for evidence of a nuclear explosion. Fifteen trucks transported 120 tons of state-of-the-art equipment from the CTBTO's equipment storage and maintenance facility near Vienna to the site, where a fully functioning base of operations was established.

The exercise in Hungary, called Build-Up Exercise III, was the last in a cycle of three exercises dating back to April 2012, which have rehearsed and tested the four phases of an OSI: Launch, Pre-Inspection, Inspection and

Post-Inspection. Build-Up Exercise III focused on an Inspection phase, in which the inspection team tested various OSI techniques, procedures, and the OSI search methodology, as well as their integration at the operational level.

With the experience and knowledge gained from exercises such as these, the CTBTO is now looking ahead to its second fully-integrated field exercise (IFE14) in Jordan in November 2014 – a major collaboration of international experts and scientists, which will test the vast majority of OSI activities and techniques over a duration of five weeks.

*Photos in this article courtesy of Matjaz Prah and Pablo Mehlhorn.*



**1** Communications both within the inspection team and from the base of operations in the field to the CTBTO headquarters in Vienna needs to be ensured at any time during the inspection. For this purpose, the CTBTO makes use of different means, including HF, UHF and VHF band communication as well as satellite based communications

**2** Passive seismological monitoring for aftershocks is another OSI technique that has been tested. Aftershocks occurring as a result of an underground nuclear test can be detected by seismic mini-arrays deployed to the field. The data gathered in the field are processed and analyzed back at the base of operations. The results help to narrow down the search area.

**3** Airborne gamma spectroscopy represents another OSI technique. For this purpose, the inspection team was permitted to conduct an additional overflight over selected parts of the inspection area. After analysis of the data, the findings were shared with other team members.





**4** Cooperative but tough: the inspected state party (ISP) insists upon its treaty rights during the conduct of the inspection. Negotiation skills of inspectors are essential and were tested throughout the entire exercise phase.

**5** As part of the exercise, a radionuclide laboratory was established at the base of operations. Cooling of the highly sensitive high-purity germanium (HPGe) detectors is required with the help of liquid nitrogen produced by a generator in the field.

**6** In addition, procedures and equipment for subsoil noble gas sampling were tested for the first time under exercise conditions. Logistical support by the inspected state party is essential in order to enable the team to fulfil its mandate.

7a



7b



**7a** Various geophysical methods such as geoelectrics were also utilized by the inspection team. These OSI techniques can detect underground anomalies caused by an underground nuclear test or its preparations.

**7b** Upon setting up the survey measurement equipment, data are stored in an acquisition system and transferred back to the base of operations for further processing and analysis.

**8** Regular inspection team meetings are essential for information sharing and mission planning purposes. "Every inspector needs to be aware about the status of operations and the planned activities ahead. The inspection team functionality concept and our search methodology provided a solid framework for planning, executing and reporting our field missions," said inspection team leader Alex Lampalzer (centre left in picture below).



## VERIFICATION SCIENCE

# The role of airborne imagery in an on-site inspection

BY ALED ROWLANDS



*Image 1:*  
Tests so far have involved mounting MSIR sensors in an external pod (see white arrow pointing to black box above wheel) on a relatively small helicopter but future tests will involve larger aircraft types.

The technologies at the disposal of inspectors during an on-site inspection (OSI) are many and varied, making it a truly multidisciplinary effort. Whilst certain OSI technologies such as seismic aftershock monitoring have been applied intensively in field tests and exercises over recent years, others require, and are subject to, developmental work. The acquisition of multi-spectral imagery from an airborne platform is a point in case.

Whilst an inspector scanning the landscape with his or her eyes has the ability to assess the OSI-relevance of features in the visible part of the spectrum, additional information can be gleaned by capturing information in discrete spectral regions (or bands) in the continuum from visible through to infrared (see figure 1). In this context the Protocol to the Comprehensive Nuclear-Test-Ban Treaty refers to this as *multi-spectral imaging including infrared measurements*, which is abbreviated to MSIR.

### HOW MULTI-SPECTRAL IMAGING IS USED

An MSIR system comprises different sensors capable of acquiring information across the visible and infrared portions of the spectrum. It can be utilized from different heights above the ground and from different platforms. Potentially, this includes oblique imagery acquired by a sensor held by an inspector on or near the ground. However, the optimal configuration is when it is mounted in an external pod or through a hatch on a fixed-wing or rotary aircraft since this allows imagery for a large area to be acquired efficiently (see image 1 above).

### TESTING THE VALUE OF MULTI-SPECTRAL IMAGING IN AN OSI

To test the effectiveness and potential value of an MSIR system to an inspection team, the Preparatory Commission for the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO) has concluded a series of field tests in Hungary incorporating realistic and



*Figure 1:*  
By displaying information from different parts of the spectrum, features such as cleared ground (red patches in image on right) are much more obvious than what can be seen in the corresponding image representing the visible portion of the spectrum (left).

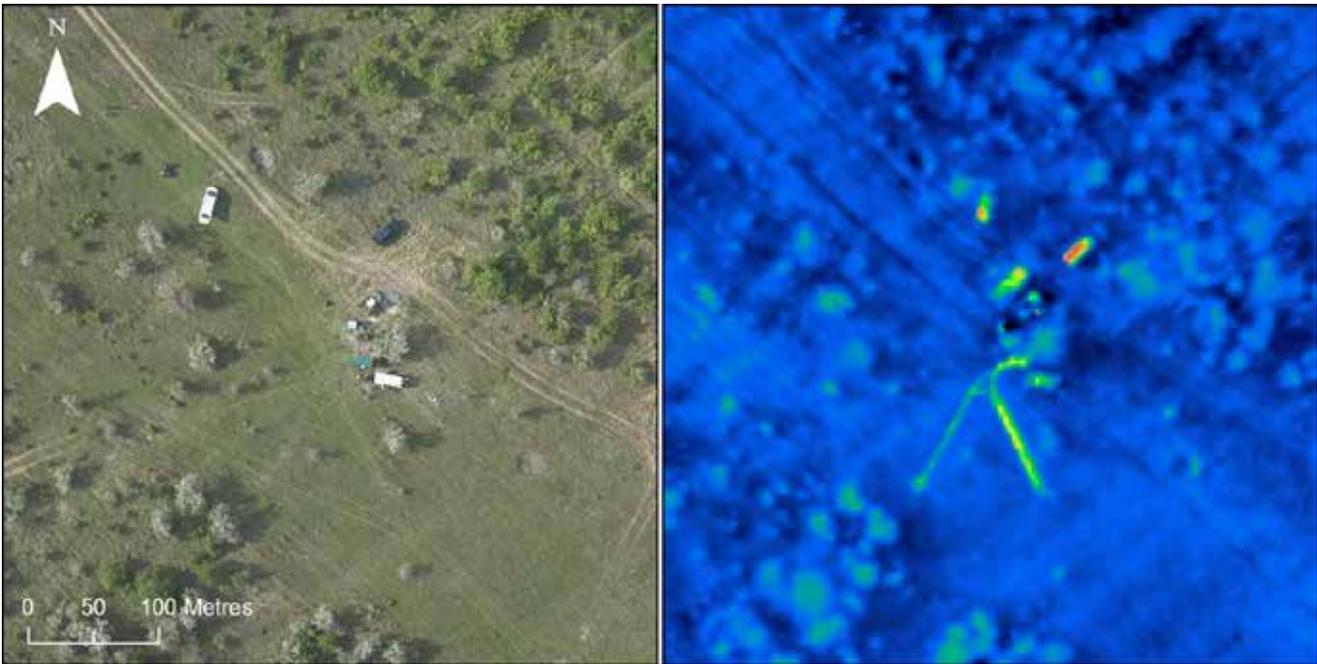


Figure 2:  
Using the thermal sensor in the MSIR system, two distinct green linear features representing subsurface warm water can be seen in the image on the right, whereas the corresponding visible image (left) does not reveal these features.

relevant observables related to potential preparation activity for an underground nuclear explosion or to secondary features related to the detonation itself. Tests have also been designed to mimic, as closely as possible, the likely timeframe of an OSI.

Features generated for testing thus far range from surface disturbances caused by vehicle movements and digging activity to changes in hydrology and surface characteristics caused by seismic shocks. To complicate matters, these features are dynamic over time and also vary depending on environmental conditions and may also be masked by surface vegetation cover and unrelated human activity. These complications need to be accounted for and have also been assessed during tests.

### DETECTING CHANGES IN GROUND WATER CAUSED BY AN UNDERGROUND NUCLEAR EXPLOSION

One potential impact of an underground nuclear explosion is a change in ground water, with cool subsurface or geothermal water being brought to the surface or to the near-surface. To test the effectiveness of MSIR to detect the consequences of this potential scenario, pipes were buried

below the surface and warm or cool water circulated, with water also being allowed to drip from the pipes to the surrounding soil. As water is circulated through the pipes the characteristics of the soil change and the thermal sensor on-board effectively records the change in soil surface temperature (see figure 2).

### DETECTING FEATURES HIDDEN BY VEGETATION

Vegetation will mask features but MSIR offers the potential to detect the impact of a detonation on vegetation and is also a means of extracting information on what lies underneath foliage. Topographic features that are obscured to inspectors on the ground or in the air due to vegetation can be revealed by using a lidar sensor, which effectively maps the elevation of the ground. This enables roads or tracks to be located, depressions recorded and subsurface features covered by soil and vegetation to be identified.

Like other OSI techniques, it is necessary to try to differentiate between those that are OSI-relevant and background features unrelated to the OSI. Whilst data processing can help in this respect, the interpretation skills of MSIR experts are fundamental in extracting

relevant information from MSIR imagery (see figures 3 and 4 on page 24).

### INTEGRATING WITH OTHER OSI TECHNOLOGIES

MSIR is one of several technologies permitted during an OSI and critically MSIR imagery and derived information do not exist in isolation, rather they become integrated with data from other technologies and analysed and displayed through the OSI geospatial system. MSIR can provide valuable information to assist OSI search logic and facilitate the work of other technologies applied during an OSI. One of the derived products of greatest value to an inspection team in this respect is aerial photography. Depending on the height of the aircraft above the ground, this photography can be of high spatial resolution and, in combination with the global navigation satellite system, can enable an inspection team member on the ground to avoid hazards and to navigate to a specific location effectively.

### CONTRIBUTING TO OSI INSPECTION TEAM FUNCTIONALITY

Whilst the nature of OSI-relevant signatures are many and varied, transient



Figure 3:  
The visible image on the left reveals little about the features lying beneath trees at locations X and Y, whilst lidar (right) shows the presence of two domed features.



Figure 4:  
The extent of depressions and the track network under forest canopy at this location are revealed in the image on the right whilst the visible image for exactly the same area reveals only some tracks leading into the forest.

and may vary depending on environmental conditions, tests conducted to date show, in principle, that the acquisition of MSIR imagery can greatly contribute to OSI inspection team functionality. This means that MSIR has the potential to play an integral role in an OSI in terms of directly promoting or demoting areas of interest and by also providing supporting imagery to the inspection team.

OSI techniques and methods will be tested in 2014 during the Integrated Field Exercise and thanks to the support of States Signatories in the form of expertise and a contribution-in-kind from Hungary, as well as financial support from the European Union, MSIR will be available to inspectors to apply for the first time in the history of the CTBTO.

#### BIOGRAPHICAL NOTE



#### ALED ROWLANDS

is a consultant in the On-Site Inspection Division at the CTBTO where he has worked since 2011. In addition to developing the airborne remote sensing component, he has participated in the build-up exercises to IFE14. Previously he held a lecturing position at Aberystwyth University in the UK and also worked in the private sector, where he specialized in the development of space and airborne remote sensing applications.

# Member States' solidarity in the verification regime build-up



The CTBTO Member States oversee and guide the establishment of the CTBT verification regime. A number of Member States from around the world have provided voluntary contributions to enable experts from the least developed countries to participate in these meetings in Vienna.

Twenty two experts from 22 different countries have received funding so far. Twenty countries and the OPEC Fund for International Development have donated over US\$ 900,000.

»OFID is proud to enable the participation of experts from developing countries in the CTBTO's technical meetings. These countries now play a more active role in the monitoring of nuclear explosions. In addition, the expertise acquired will help them to make use of CTBTO data for disaster warning and science at home.«

**SULEIMAN J. AL-HERBISH**  
DIRECTOR-GENERAL OF THE OPEC FUND  
FOR INTERNATIONAL DEVELOPMENT

»Banning nuclear testing concerns all countries alike, and our aim is to see the CTBT being universalized and entering into force. Capacity building is crucial in this respect, and therefore Norway has supported experts from developing countries to participate and become stakeholders in the CTBT verification regime.«

**JAN PETERSON**  
CHAIRMAN OF THE CTBTO  
PREPARATORY COMMISSION

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»The project is an important pillar in our efforts to help developing countries master the CTBT verification technologies. Its generous funding is not only a sign of the strong political support for the CTBT and its verification regime, but also tangible confirmation of the spirit of cooperation and mutual support amongst CTBTO Member States.«

**LASSINA ZERBO**  
EXECUTIVE SECRETARY OF THE  
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“The CTBT has been waiting in the sidelines for more than 16 years for the international community to affirm its full entry into force by completing the process of signatures and ratifications.

I would like to take this opportunity to add my voice to that of all peace-loving men and women to launch an appeal to all States whose signature and ratification is still needed for the Treaty’s entry into force.”

**BLAISE COMPAORE**

PRESIDENT OF BURKINA FASO

*Read President Compaoré’s  
contribution on page 4 of this issue*

# GEM

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Group of Eminent Persons

It is an honour to introduce the members of the Group of Eminent Persons, GEM, through this booklet. GEM comprises a number of global leaders, senior political figures and high-ranking diplomats from States Signatories. The Group shall support ongoing efforts to achieve the early entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). With their wide-ranging expertise and experience, members of GEM will bring fresh impetus to the ongoing dialogue with the eight countries whose ratification is required for the CTBT's entry into force, namely: China, the Democratic People's Republic of Korea (DPRK), Egypt, India, Iran, Israel, Pakistan and the United States.

I would like to take this opportunity, on behalf of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), to thank each member for his/her commitment to the noble goals of the Treaty. I am certain that through our collective efforts, we will put an end to nuclear explosions once and for all.

Lassina Zerbo  
Executive Secretary, CTBTO



## NOBUYASU ABE

Nobuyasu Abe served as the United Nations Under-Secretary-General for Disarmament Affairs from 2003 to 2006. He was the Ambassador of Japan to the International Atomic Energy Agency and other international organizations in Vienna from 1999 to 2001, and Director-General for Arms Control and Science at the Japanese Ministry of Foreign Affairs from 1997 to 1999. He currently holds the position of Director of the Center for the Promotion of Disarmament and Non-Proliferation at the Japan Institute of International Affairs.



## HANS BLIX

Hans Blix is a diplomat and politician who was the Swedish Minister for Foreign Affairs from 1978 to 1979. He subsequently served as the Director General of the International Atomic Energy Agency from 1981 to 1997. From 2000 to 2003 Blix was Executive Chairman of the United Nations Monitoring, Verification and Inspection Commission which investigated Iraq's compliance with its obligation to be rid of its weapons of mass destruction.



## DES BROWNE

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Des Browne, Lord Browne of Ladyton, is a British Labour Party politician and a former Member of Parliament. He served as the United Kingdom's Secretary of State for Defence from 2006 to 2008 and as Secretary of State for Scotland from 2007 to 2008. A member of the House of Lords since 2010, he is now the Convenor of the Top Level Group of UK Parliamentarians for Nuclear Disarmament and Non-Proliferation, and the Chair of the Executive Board of the European Leadership Network.



## JAYANTHA DHANAPALA

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Jayantha Dhanapala served as the United Nations Under-Secretary-General for Disarmament Affairs from 1998 to 2003. He served as Ambassador of Sri Lanka to the United States of America from 1995 to 1997 and to the UN Office in Geneva from 1984 to 1987. He is currently the 11th President of the Nobel Peace Prize-winning Pugwash Conferences on Science and World Affairs, Deputy Chairman of the Governing Board of the Stockholm International Peace Research Institute (SIPRI), and is a member of several other advisory boards of international bodies.



## CRISTIAN DIACONESCU

Cristian Diaconescu is currently the Chief of Staff and Adviser to the President of Romania, Traian Băsescu. He served as Romania's Minister of Foreign Affairs in 2012 and from 2008 to 2009. Diaconescu sat in the Romanian Senate from 2004 to 2012, serving as Minister of Justice in 2004. Prior to this he was Secretary of State for Bilateral Affairs at the Foreign Affairs Ministry. He represented Romania as deputy Head of Mission to the United Nations and the Organization for Security and Co-operation in Europe (OSCE) in Vienna.



## WOLFGANG HOFFMANN

Wolfgang Hoffmann served as the first Executive Secretary of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization from March 1997 until August 2005. Prior to this he was the German Ambassador to the Conference on Disarmament in Geneva from 1993 to 1997, where negotiations for the Comprehensive Nuclear-Test-Ban Treaty took place between 1994 and 1996. A lawyer by profession, Hoffmann entered the German Foreign Service in 1965 where he held different positions, especially in the multilateral field.



## JOHN HUTTON

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John Matthew Patrick Hutton, Lord Hutton of Furness, is a British Labour Party politician and was a Member of Parliament from 1992 to 2010. He served as the United Kingdom's Defence Secretary of State from 2008 to 2009 and as Secretary of State for Business, Enterprise and Regulatory Reform from 2007 to 2008. He is currently Chairman of the Royal United Services Institute for Defence and Security Studies and a Member of the House of Lords, where he has served since 2010.



## IGOR IVANOV

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Igor S. Ivanov is the President of the Russian International Affairs Council (RIAC) and a Professor at the Moscow State Institute of International Relations. Previously, he served as Minister of Foreign Affairs of the Russian Federation from 1998 to 2004 and as Secretary of the Security Council of the Russian Federation from 2004 to 2007. He holds the rank of Ambassador Extraordinary and Plenipotentiary and is a corresponding member of the Russian Academy of Sciences.



## JOHANNES KYRLE

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Johannes Kyrle has served as Secretary-General of Austria's Ministry of Foreign Affairs since 2002. During this time he has also been a member of the National Security Council, advising the Federal Government on principal matters of foreign, security and defence policy. From 1997 to 2002 he was the Chief of Protocol at the Austrian Foreign Ministry and the Austrian Ambassador to the Principality of Liechtenstein with residence in Vienna from 1991 to 2002.



## HO-JIN LEE

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Ho-Jin Lee, formerly a career diplomat of the Republic of Korea (ROK), is Principle Vice President of the United Nations Association of the ROK. He has specialized in East Asian security, arms control and non-proliferation, and nuclear energy. He was the ROK's Ambassador to Finland from 2008 to 2010, to Hungary from 2003 to 2006, and Ambassador and Deputy Permanent Representative to the UN from 2001 to 2003. He served as a member of the UN Advisory Board on Disarmament Matters from 2004 to 2008 and as its chairman in 2007.



## XOLISA MABHONGO

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Xolisa Mabhongo has been the Permanent Representative of South Africa to the United Nations and international organizations in Vienna as well as Ambassador to Austria, Slovakia and Slovenia since January 2010. He was the Chairman of the CTBTO Preparatory Commission in 2010 and is a member of the Board of Governors at the International Atomic Energy Agency. He was also the head of the UN Political Affairs desk of the South African Foreign Ministry between 2006 and 2009.



## FEDERICA MOGHERINI

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Federica Mogherini is President of the Italian delegation to the NATO Parliamentary Assembly and a member of the Committees on Foreign Affairs and Defence in the Italian parliament. She was elected to the parliament's Chamber of Deputies in 2008, where she has served as Secretary of the Defence Committee and as a member of the Parliamentary Assembly of the Council of Europe. Mogherini specializes in foreign policy and international security issues.



## MARC PERRIN DE BRICHAMBAUT

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Marc Perrin de Brichambaut has been a State Councillor in the Litigation Section of the State Council (Conseil d'Etat) in Paris since 2012. He served as Secretary General of the Organization for Security and Co-operation in Europe (OSCE) from 2005 to 2011. Since entering public service in 1974, he has held a variety of senior positions in the French civil service, including Ambassador and Head of the French Delegation to the OSCE from 1991 to 1994.



## KEVIN RUDD

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Kevin Rudd is a member of the Australian Parliament. He was Prime Minister of Australia and Leader of the Australian Labor Party (ALP) from June to September 2013 and from December 2007 to June 2010. He was the Australian Minister for Foreign Affairs from 2010 to 2012. Previously, in Opposition he was the shadow Minister for Foreign Affairs from 2001 until 2006 when he became the leader of the ALP. Prior to joining Parliament, Rudd was a diplomat, a senior adviser and then official in the Queensland State Government and a business consultant on China.



## SHA ZUKANG

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Sha Zukang served as the United Nations Under-Secretary-General, Department of Economic and Social Affairs, from 2007 to 2012. In 2010 he was nominated as the Secretary General of the 2012 UN Conference on Sustainable Development. From 2001 to 2007 he served as the Permanent Representative of China to the UN Office at Geneva. He established the Department of Arms Control in the Chinese Ministry of Foreign Affairs, which he headed from 1997 to 2001. As Ambassador of Disarmament Affairs from 1995 to 1997, Sha was China's chief negotiator of the CTBT.



## HÉCTOR TIMERMAN

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Héctor Timerman has been the Minister of Foreign Affairs of Argentina since 2010. Prior to this he served as the country's Ambassador to the United States of America from 2007 to 2010. Timerman is the co-founder of Americas Watch, the western hemisphere chapter of Human Rights Watch, and directed the Buenos Aires office of the Permanent Assembly for Human Rights from 2002 to 2004. He also worked as a columnist for The New York Times, Los Angeles Times, Newsweek and other international media.

## EX OFFICIO MEMBERS

CO-PRESIDENTS OF THE PROCESS TO FACILITATE THE ENTRY INTO FORCE OF THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY



### JÁNOS MARTONYI

János Martonyi was appointed Minister of Foreign Affairs of Hungary in 2010, a position which he also held from 1998 to 2002. Between 1994 to 1998, and 2002 to 2009, he was Managing Partner of Martonyi and Kajtár, Baker & McKenzie Law Firm in Hungary. Previous political posts have included Administrative State Secretary at the Ministry of Foreign Affairs from 1991 to 1994 and at the Ministry for International Economic Relations from 1990 to 1991. He is a professor of International Trade Law at the University of Szeged.



### MARTY M. NATALEGAWA

Marty M. Natalegawa was appointed Foreign Minister of the Republic of Indonesia in 2009. From 2007 to 2009 he served as the Permanent Representative of Indonesia to the United Nations in New York and as Ambassador to the United Kingdom from 2005 to 2007. He served consecutively as Chief of Staff of the Office of the Minister for Foreign Affairs and as the Deputy Minister for the Association of Southeast Asian Nations (ASEAN) Cooperation in the Department of Foreign Affairs from 2002 to 2005.



As of 16 September 2013, GEM comprised 18 members including Ministers János Martonyi and Marty M. Natalegawa, who will serve as ex officio members (please refer to page 9). Any updates to the list of members will be reflected in the online version of the booklet, which is available on our website: [www.ctbto.org](http://www.ctbto.org)

