WWW.CTBTO.ORG

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

19

CTBTO SPECTRUM

CTBTO MAGAZINE ISSUE 19 | SEPTEMBER 2012

Reykjavik

Vision of a world without nuclear weapons

CHILE'S FOREIGN MINISTER
ALFREDO MORENO

FINLAND'S FOREIGN MINISTER
ERKKI TUOMIOJA

FORMER UN UNDER-SECRETARY-GENERAL FOR DISARMAMENT AFFAIRS
JAYANTHA DHANAPALA

FORMER DIRECTOR OF LOS ALAMOS NATIONAL LABORATORY
SIEGFRIED HECKER

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 2012, 183 countries had signed the Treaty and 157 had ratified it. Of the 44 nuclear capable States which must ratify the CTBT for it to enter into force, the so-called Annex 2 countries, 36 have done so 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. On February 6 2012, Indonesia completed its ratification of the CTBT.

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 2012 over 80 percent of the facilities at the International Monitoring System (IMS) were operational.

COVER IMAGE:
Ronald Reagan and Mikhail Gorbachev at the Reykjavik summit in 1986.
Photo Courtesy of David & Peter Turnley/Corbis

COVER DESIGN:
Krzysztof Kolasinski

TABLE OF CONTENTS

EDITORIAL
TIBOR TÓTH
EXECUTIVE SECRETARY

This year on 27 September, foreign ministers will once again gather at the United Nations Headquarters in New York to promote the entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Participants will make a commitment at the highest political level regarding the urgency of securing this objective. The meeting will result in a Joint Ministerial Statement appealing to all States to make the utmost effort to establish a legally-binding, comprehensive prohibition on all nuclear explosions.

One of the conveners of the meeting, Finland's Foreign Minister Erkki Tuomioja, argues in this issue of Spectrum that the CTBT's entry into force will considerably strengthen the global security architecture and benefit the whole world. Nuclear scientist Siegfried S. Hecker comes to a similar conclusion, maintaining that nuclear possessor States stand to gain more than they lose from CTBT ratification. And former UN Under-Secretary-General for Disarmament Affairs, Jayantha Dhanapala, urges more countries to follow the example of Indonesia and ratify the Treaty, showing how Asian nations can lead by example.

By banning all nuclear explosions, the Treaty's political benefits are evident. Less obvious is the contribution of CTBT monitoring data to disaster mitigation, such as tsunami warnings. State-of-the art facilities making up the International Monitoring System (IMS) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) have been sharing their data with tsunami warning centres around the world since 2005.

Chile's Foreign Minister Alfredo Moreno describes in his article the important role of the IMS when the magnitude 8.8 earthquake struck Chile on 27 February 2010, claiming many lives. About 20 IMS seismic stations sent their data within less than one minute to the CTBTO in Vienna, where they were forwarded immediately to tsunami warning centres in the Pacific Ocean. One of the stations that contributed to this early warning effort, hydroacoustic station HA03 on Juan Fernandez Island, around 600 kilometres off the Chilean coast, was itself subsequently destroyed by the tsunami wave and is currently being rebuilt.

Tatsujiro Suzuki of the Japan Atomic Energy Commission highlights the significance of another application of CTBT data: monitoring the spread of radioactive particles and noble gases around the globe, as was the case after the Fukushima nuclear accident. The Foreign Editor of Hindustan Times, *Pramit Pal Chaudhuri, also refers to the use of CTBT verification data for disaster mitigation, which, in his opinion, is an added incentive for India to join the Treaty.*

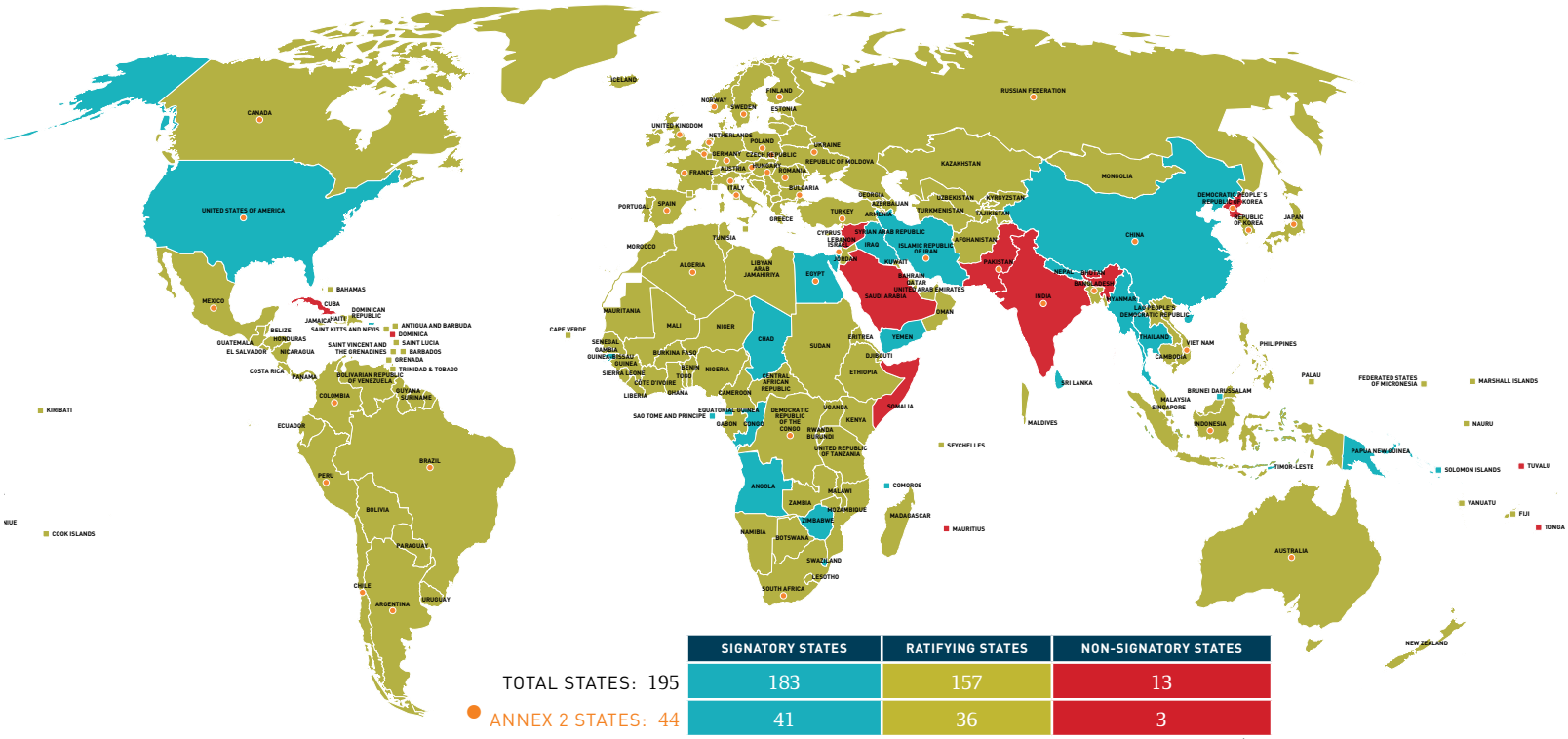
The raison d'être of the IMS is, of course, to detect nuclear explosions, but nuclear testing will only be outlawed once the CTBT has entered into force. Ik Bum Kang, the former Project Manager of primary seismic station PS31 in the Republic of Korea, describes the role the station played when North Korea conducted its first nuclear test on 9 October 2006. North Korea is one of eight countries that must sign and/or ratify the Treaty before it can enter into force.

While preparing for this, the CTBTO is carrying out a number of on-site inspection exercises and field experiments. In her article, former CTBTO staff member Kirsten Haupt takes an in-depth look at some of the exercises leading up to the next full-scale on-site simulation in Jordan in 2014. She provides readers with an impression of the vast technical and logistical challenges involved.

Non-proliferation training and education activities also play a pivotal role in promoting the Treaty and its verification regime. In this respect, the CTBTO launched the Capacity Development Initiative (CDI) in 2011 to train the next generation of experts in all legal, political, technical and scientific aspects of the CTBT and its verification regime. Elena Sokova of the Vienna Center for Disarmament and Non-Proliferation concludes that the availability of dedicated disarmament and non-proliferation programmes and courses falls short of demand and should be more comprehensive, sustainable, and global. The CDI is therefore a timely and welcome development in this field, she explains.

The cessation of all nuclear tests would be a monumental step towards the elimination of nuclear weapons, a goal which US President Ronald Reagan and Soviet General Secretary Mikhail Gorbachev came close to achieving at the 1986 summit in Reykjavik, Iceland. More than 25 years later, the meeting's potential to fundamentally change the course of history continues to ignite the imagination. In order to stimulate debate on the lessons learned, opportunities missed and what is needed today to move forward with nuclear disarmament, the CTBTO is organizing a reading of the play 'Reykjavik' by Pulitzer Prize winner Richard Rhodes on 27 September 2012 in New York. The reading will be followed by a panel discussion entitled '25 years since Reykjavik – will we get it right in the next 25?' Gorbachev will deliver a video message to open the discussion, which will feature key players from the 1986 summit. Progress towards the CTBT's entry into force over the coming years will be a sure indicator of whether the lessons learned from the Reykjavik summit have been heeded.

STATUS OF SIGNATURES AND RATIFICATIONS
AS OF 3 SEPTEMBER 2012



	SIGNATORY STATES	RATIFYING STATES	NON-SIGNATORY STATES
TOTAL STATES: 195	183	157	13
● ANNEX 2 STATES: 44	41	36	3

FOR MORE DETAILED INFORMATION ON SIGNATURE AND RATIFICATION VISIT WWW.CTBTO.ORG/MAP

CTBTO Faces

CTBTO Faces is a newly-launched online collection of interviews with people whose ideas, lives and work help define global nuclear affairs.

Each week, a new in-depth interview is added to the series, building a unique archive of opinions and insights.

Watch our video interviews at:
ctbto.org/faces

The CTBT and its data

A powerful instrument for peace and human security

BY ALFREDO MORENO
CHILE'S MINISTER
OF FOREIGN AFFAIRS

Verification data provided by the CTBTO contributes to disaster prevention and mitigation and therefore serves as a useful diplomatic opportunity to convince States to sign and ratify the Treaty, writes Chile's Foreign Minister Alfredo Moreno, who also emphasizes the data's potential and encourages more civil institutions around the globe to take advantage.

On 24 September 2012, the international community will commemorate 16 years of the opening for signature of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The Treaty, perceived as a crucial milestone in the process leading to the abolition of nuclear weapons and – in the meanwhile – a substantive confidence-building measure, was warmly received in Latin America and the Caribbean, the first densely populated region to collectively embrace the vision of a nuclear-weapon-free world through the Tlatelolco Treaty. Our countries were vocal opponents of the nuclear tests conducted in the South Pacific and have remained steadfast in their rejection of atomic weapons and their means of delivery.

1996 was a momentous year for Chilean multilateral diplomacy: our country became a member of the Conference on Disarmament within a group of 23 States (the so-called G-23) coordinated by Ambassador Jorge Berguño, the Permanent Representative of Chile in Geneva. This move signalled an unswerving commitment to nuclear disarmament expressed ever since at every multilateral, regional and sub-regional forum and through active participation in like-minded groups, including the De-Alerting Coalition and the Nuclear Non-Proliferation and Disarmament Initiative (NPDI), created in 2010 by Australia, Canada, Chile, Germany, Japan, Mexico, the Netherlands, Poland, Turkey and the United Arab Emirates, to work for a thorough implementation of the 2010 Nuclear Non-Proliferation Treaty (NPT) Review Conference's Plan of Action.

THE CTBT: ONE STEP CLOSER TO UNIVERSALIZATION

2011 proved to be a good year for the CTBT: in Indonesia – an Annex 2 State with global stature – the country's parliament approved ratification of the Treaty in December, subsequently depositing the instrument of ratification with the United Nations Secretary-General on 6 February 2012. This lowered to eight the number of ratifications needed for its entry into force. In our region, 2012 began auspiciously when Guatemala ratified the Treaty on 12 January, bringing the CTBT a step closer to universalization. These significant sovereign decisions increased the pressure on key States to exercise their leadership and accelerate their ratifications.

The CTBT provides the legal framework for a prohibition well grounded in the collective conscience of humankind: nuclear testing has become a policy option truly deprived of legitimacy and as such it finds no place in the conduct of States in the 21st Century.

Furthermore, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) has efficiently put in place most of the verification mechanisms provided for by the Treaty: the International Monitoring System (IMS) and the International Data Centre (IDC) are concrete realities, already delivering their products, as was confirmed in 2006 and 2009 on the occasion of the infamous nuclear tests by the Democratic People's Republic of Korea (DPRK). On-site inspections are also key to the future verification system. In this regard we are satisfied to see that work is well underway for organizing the next Integrated Field Exercise to be held in late 2014 in Jordan, which will allow an international team of inspectors monitored by observers to conduct a complete on-site inspection.

»The CTBT provides the legal framework for a prohibition well grounded in the collective conscience of humankind: nuclear testing has become a policy option truly deprived of legitimacy and as such it finds no place in the conduct of States in the 21st Century. «

CTBTO DATA FOR DISASTER MITIGATION

Chile contributes to the verification system with seven IMS stations watching over a vast pelagic space in the south eastern quadrant of the Pacific Ocean. These stations comprise all the technologies available to the IMS: seismic, infrasound, hydroacoustic and radionuclide. Two of them – located on Robinson Crusoe Island in the Juan Fernández archipelago – were wiped away by the tsunami ensuing the 8.8 Richter scale earthquake which struck our country in the small hours of 27 February 2010 (the eighth strongest earthquake in the history of the Richter scale). But another 20 seismic and hydroacoustic stations from the monitoring network provided crucial data, shared immediately with tsunami warning centres in the Pacific. Work on the reconstruction of both stations at Robinson Crusoe Island is progressing smoothly with close support from the Chilean Government and the local community.

The cataclysmic tsunami precipitating the crisis at the Fukushima Daichii nuclear power plant provided yet more proof of the crucial IMS contribution to human security: Japanese authorities confirmed that on 11 March 2011, real-time data provided by CTBT stations triggered public alerts within minutes of the magnitude 9.0 earthquake, allowing many people to reach safety on higher ground. In the following weeks, the IMS was able to track the dispersion of radioactive substances, enhancing a preventive response and providing expert advice to relevant organizations concerned with disaster prevention and mitigation.

Both tragedies confirmed the human security potential of the verification array created by the Treaty, which – while not its raison d'être – reaffirms the usefulness of an otherwise considerable investment from the CTBTO Member States. This humanitarian complement was underlined by the foreign ministers

Damage caused by the magnitude 8.8 earthquake that struck Chile on 27 February 2010.

Installing the underwater cable of hydroacoustic station HA03, Juan Fernandez Island, Chile, in 2003.

Juan Fernandez Island, Chile, showing the aftermath of the February 2010 tsunami. The IMS hydroacoustic station HA03 was destroyed by the tsunami.

of the NPDI in our statement at the General Assembly's High Level Segment, last September:

"We reiterate our commitment to universalizing the CTBT and promoting its early entry-into-force. While striving towards this goal, we recognize the security and civil benefits of the CTBT verification system, including the International Monitoring System. Members of the NPDI will continue to utilize diplomatic opportunities to urge states that have not done so to sign and ratify the Treaty."

The 2005 United Nations summit established that "peace and security, development and human rights are the pillars of the United Nations system and the foundations for collective security and well being. "At the same time, it recognized that "development, peace and security and human rights are interlinked and mutually reinforcing[1]." This imperative of interdependence should preside over every multilateral endeavour and certainly all that we do in Vienna. Thus the Chilean Delegation participating in the preparatory process of the International Atomic Energy Agency's (IAEA) Ministerial Conference on Nuclear Safety convened last June joined the voices advocating for increased emergency cooperation between the IAEA and the CTBTO, and providing expert advice to relevant organizations concerned with disaster prevention and mitigation. We stand ready to keep working with other Member States at both organizations to adopt mandates underpinning an efficient humanitarian response.

A globalized world needs globalized mindsets. International organizations are tools for a collective response to interlinked global needs: thus we conceive them as global public goods interwoven both in nature and vocation. Old-fashioned compartmentalization will not do in times of scarcity but ever mounting challenges. Data are the lifeblood of the information society and the data gathered by the CTBTO ought to be treated as a global contribution with benefits unforeseen in 1996. For instance, to have a better understanding of a planet that, as those sitting near the Pacific Belt of Fire know rather well, refuses to stay quiet.

PROMOTING THE USE OF MONITORING DATA

The civil and scientific applications of this monitoring system are of particular interest for developing countries. Member States are entitled to benefit from the information gathered by the IDC but the responsibility over its national use rests upon their shoulders. CTBTO data could reach many more universities, investigation laboratories, observatories and emergency-response organizations than today – even in my own country. Accordingly, we have a global and domestic task to promote the profitable use of our own products.

We look with optimism at the potential of the CTBTO and its verification regime and we were honoured to contribute to the success of the organization from January to June 2012 when Ambassador Alfredo Labbé Villa of Chile served as Chairman of the executive body of the CTBTO, the PrepCom.

[1] Resolution A/60/1, paragraph 9.

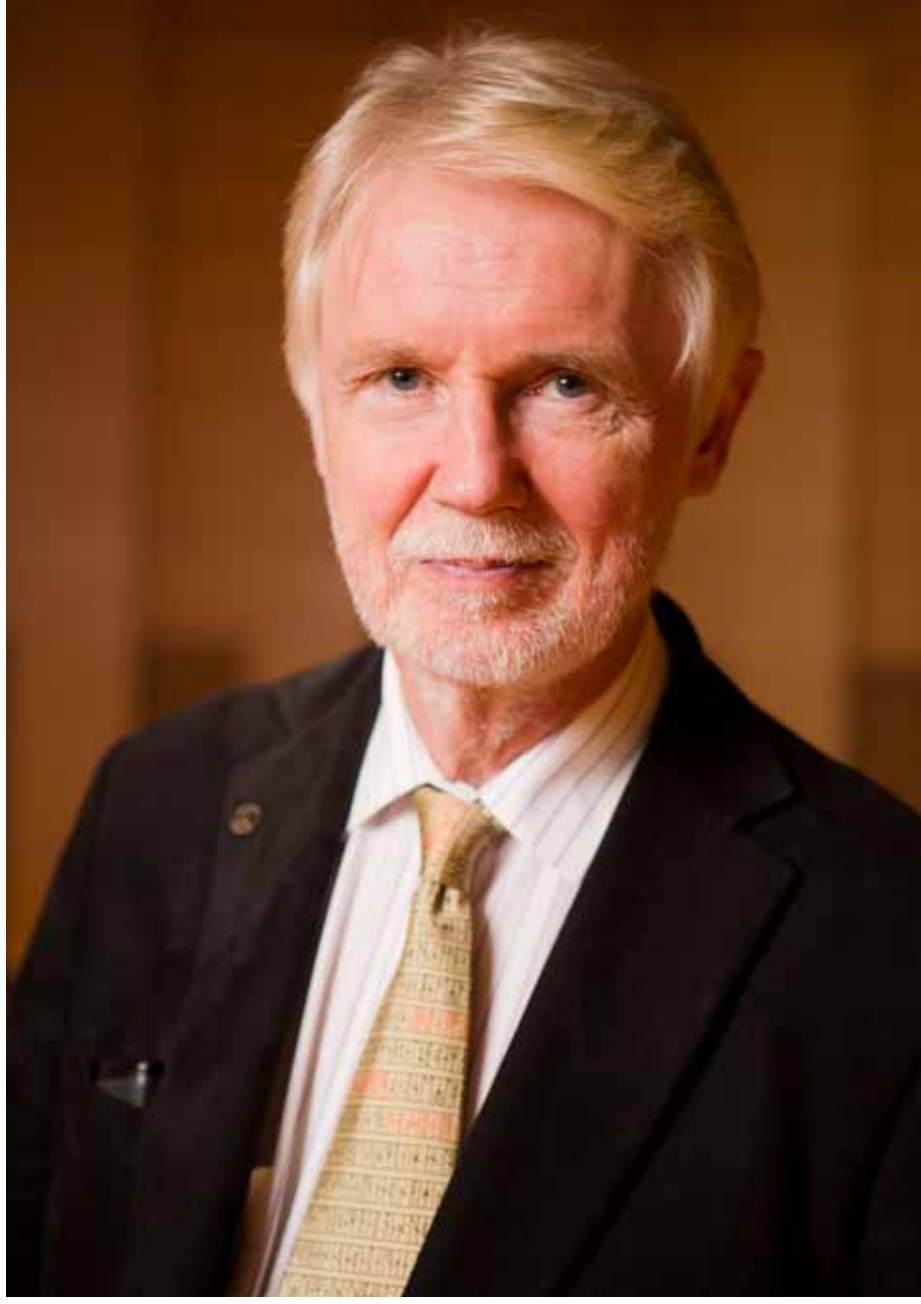
BIOGRAPHICAL NOTE

ALFREDO MORENO
is Minister of Foreign Affairs of Chile. He is a member of G-50, a group of 50 Latin American leaders selected by *Foreign Policy,* one of the world's leading publications on international relations in the US. Minister Moreno is also a member of the International Cabinet of the Dom Cabral Foundation in Brazil, as well as of the Global Advisory Board at the University of the Chicago Booth School of Business.

Dual dividends

The CTBT strengthens global security architecture and benefits the whole world

BY ERKKI TUOMIOJA,
MINISTER FOR FOREIGN
AFFAIRS OF FINLAND



As one of the organizers of the CTBT Ministerial Meeting in New York on 27 September, Finland's Foreign Minister Erkki Tuomioja states that while the current voluntary moratorium on nuclear weapon tests is important, it cannot be a substitute for a global ban. In addition, he points out the significant role of the CTBTO not only in detecting nuclear explosions but also in contributing to human welfare.

Finland is a faithful supporter of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). My country signed the Treaty on the very same day it was opened for signature in 1996 and ratified it in early 1999. Because it has nuclear energy power plants, Finland is one of the 44 Annex 2 States whose ratification is needed before the Treaty can enter into force.

The CTBT is frequently quoted as a core element of the worldwide nuclear disarmament and non-proliferation regime. I fully agree. It is in our common interests that no new nuclear weapons are developed and no new nuclear weapons States emerge. The verification regime embedded in the Treaty is an important tool to make sure that the ban is respected. By signing and ratifying the Treaty we have committed ourselves to constructing a verification system that will be fully operational by the time the Treaty enters into force. That work is proceeding well. During the time that the verification system has been developed it has become evident that its usefulness extends way beyond its original purpose of monitoring compliance with the CTBT.

Through its network of 337 monitoring facilities – the International Monitoring System (IMS) – the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) has also proven its potential, effectiveness and usefulness with regard to civil and scientific applications. The IMS provides accurate information not only to countries around the world but also to many international organizations like the International Atomic Energy Agency (IAEA), the World Meteorological Organization (WMO) and the World Health Organization (WHO). We witnessed during last year's Fukushima catastrophe that the CTBTO data could help Japan and other countries in the region to issue tsunami warnings within a few

»The verification system's usefulness extends way beyond its original purpose of monitoring compliance with the CTBT.«

Model of the inside of the Chernobyl nuclear power plant after the disaster. The lid of the reactor (metal, center) was blown off. Photo from Chernobyl Museum, Kiev, Ukraine. Some CTBTO monitoring stations continue to detect radionuclides from the accident at the Chernobyl nuclear power plant in 1986.

minutes time, allowing many people to escape to higher ground. I am convinced that the added value of the IMS data for natural and man-made disaster prevention and mitigation will continue to increase in the future. Through the CTBT we can promote the wealth of our planet and we can contribute in many ways to human welfare.

ENSURING NUCLEAR SAFETY AND SECURITY

Since May 2000, Finland has hosted two IMS facilities: a station in Lahti and a radionuclide laboratory in Helsinki. Finland was the 11th Member State to sign a facility agreement with the CTBTO. The cooperation between the facilities and the CTBTO is excellent.

Nuclear safety and security are of utmost importance to my country. The safety of Finland's nuclear power plants is strictly regulated by STUK, the independent Radiation and Nuclear Safety Authority of Finland. However, the accidents in Chernobyl and Fukushima have proven that there are no borders in nuclear catastrophes. Accidents can take place unexpectedly anywhere. Therefore, the CTBTO's monitoring system is of great importance in detecting the dispersion of radioactive materials and delivering early warnings.

My country plays an active role in promoting the universalization of the CTBT. Together with other 'Friends of the CTBT' we have offered our strongest political and practical support to the CTBT and its entry into force. As I stated at the Conference on Facilitating the Entry into Force of the CTBT in New York last September, it is time to act now: Finland calls upon all States that have not yet signed and ratified the CTBT to do so without further delay. I warmly congratulate Indonesia, which ratified the CTBT on 6 December[1], on the Finnish Independence Day. Indonesia is a good example for the eight remaining Annex 2 States to follow suit and ratify without further delay.

CONTINUING EFFORTS TO CLOSE THE DOOR ON NUCLEAR TESTING

We should keep in mind the successful outcome of the 2010 Review Conference of the Nuclear Non-Proliferation Treaty (NPT), and continue making efforts in nuclear disarmament. Finland has accepted the challenge of acting as both the facilitator and host of a conference in December 2012 on the establishment of a Middle East zone free of nuclear weapons and all other weapons of mass destruction.

The current voluntary moratorium on nuclear weapon tests is of great importance, but I wish to underline that it cannot be a substitute for a global ban. It is time to close the door on nuclear weapon tests. The CTBT's entry into force will considerably strengthen the world's security architecture and benefit the whole world. To quote the UN Secretary General, Ban Ki-moon: "Even before entering into force, the CTBT is saving lives." Let's save more lives! Let's do it – now, in 2012!

[1] The ratification process was completed when Indonesia deposited the instrument of ratification with the UNSG on 6 February 2012.

BIOGRAPHICAL NOTE

ERKKI TUOMIOJA
is the Finnish Minister for Foreign Affairs. Prior to his appointment in June 2011, he was Chairman of the Grand Committee for EU Affairs from 2007 to 2011, Minister for Foreign Affairs from 2000 to 2007 and Minister of Trade and Industry from 1999 to 2000. Minister Tuomioja served as Vice-Chairman and then Chairman of the Social Democratic Party Parliamentary Group between 1991 and 1999 and as Deputy Mayor of Helsinki from 1979 to 1991. He has been a Member of Parliament since 1970.

CTBTO SPECTRUM IN THE APP STORE

ALL EDITIONS ON THE IPAD. SUBSCRIBE NOW FOR FREE.

Defusing the nuclear powder keg

How Asian nations can lead by example

BY JAYANTHA DHANAPALA
FORMER UN UNDER-SECRETARY-GENERAL
FOR DISARMAMENT AFFAIRS

Former UN Under-Secretary General for Disarmament Affairs, Jayantha Dhanapala praises Indonesia's ratification of the CTBT and argues that each additional ratification sends a clear political message to the remaining hold-out States.

If our cricket-crazy South Asian subcontinent knows the Sri Lankan hill-country town of Pallekelle — in the suburbs of my hometown of Kandy — for anything, it is for the Pallekelle International Cricket Stadium where some of the 2011 World Cup Cricket matches were played.

However, Pallekelle is also home to another, more inconspicuous but no less important complex: a monitoring station to detect nuclear explosions. It is a part of an unprecedented global alarm system built by the Vienna-based Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

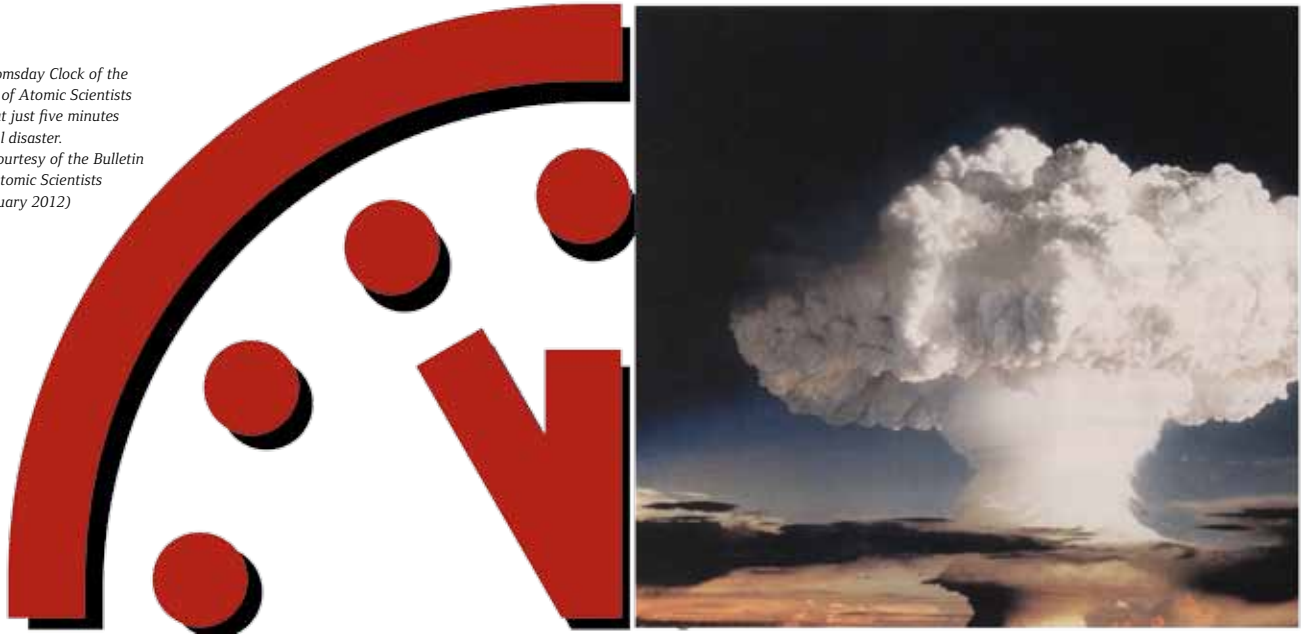
SENSORS ACROSS THE WORLD

Monitoring technologies have evolved far beyond what was envisaged at the time of the system's conception in the 1990s. When complete, over 300 state-of-the-art sensors in every corner of the world will listen to the atmosphere, the oceans and underground for shock waves from a nuclear blast. Radionuclide stations sniff the air for radioactivity — the 'smoking gun' of any nuclear test. Thanks to the most elaborate verification system in the history of arms control, of which 290 facilities are now operational, the international community can rest assured that all nuclear tests of military significance will be detected, as indicated in the March 2012 National Academy of Sciences report on *The Comprehensive Nuclear-Test-Ban Treaty (CTBT): Technical Issues for the United States*. The system has already proved its effectiveness by detecting the North Korean tests in 2006 and 2009, despite their low yield and the fact that considerably fewer monitoring stations were operational then.

THE 'DOOMSDAY CLOCK' - ONE MINUTE CLOSER TO MIDNIGHT

Although the CTBTO is celebrating its 15th birthday this year and has come a long way in establishing its formidable verification system, the CTBT has yet to become global law. This is one of the main reasons why, in my presence on January 10 in Washington D.C. this year, the Bulletin of Atomic Scientists decided to adjust the hands of its 'Doomsday Clock' — a symbolic measure which counts down to nuclear Armageddon — one minute closer to midnight: it is now set at 11:55, five minutes before global disaster.

»Opposing the CTBT because it fails to deliver complete disarmament is tantamount to opposing speed limits on roads because they fail to prevent accidents completely.«



The Doomsday Clock of the Bulletin of Atomic Scientists stands at just five minutes to global disaster. Photo courtesy of the Bulletin of the Atomic Scientists (10 January 2012)

Veteran Nepalese diplomat Hira B. Thapa recently wrote about the looming danger of nuclear warfare in South Asia for his country. I share the same fears for Sri Lanka. The detonation, accidental or planned, of even a single nuclear weapon in this part of the world, would be catastrophic for the region. A nuclear exchange between India and Pakistan would cause a global nuclear winter leading to years of widespread famine, as Professors Alan Robock from Rutgers University and Owen Brian Toon from the University of Colorado, United States, have predicted. Nuclear war in South Asia can be triggered by States or non-State actors, by accident or design – as long as nuclear weapons exist in the region.

HAMPERING QUALITATIVE IMPROVEMENTS OF NUCLEAR WEAPONS

A crude Hiroshima-bomb type weapon can be developed without testing, yet the development of more advanced nuclear weapons continues to rely on testing.

The CTBT was never meant to be a cure-all. It addresses one, albeit crucial aspect: hampering qualitative improvements of nuclear weapons. It could make a difference – whether a 'simple' nuclear weapon is at stake or a thermonuclear weapon with apocalyptic destructive power.

Only eight specific ratifications are missing for the CTBT to enter into force: the United States, China, Iran, India, Pakistan, Egypt, Israel, and North Korea. In February 2012, Indonesia decided to leave this group and join the 156 countries that had already ratified the CTBT, while the Obama Administration has pledged to resubmit the Treaty to the US Senate for advice and consent.

Since its inception in 1996, the CTBT's zero-testing norm is the expression of a zero-tolerance stance against nuclear testing, treated nowadays as a reckless and atavistic display of nuclear weapon possession. It is my hope that other countries in the wider Asian region will follow Indonesia's shining example.

ON PEACE AND THE ENVIRONMENT

The non-nuclear weapon States in our region could make a difference by leading through example: among the Association of South East Asian Nations (ASEAN), only Brunei, Myanmar and Thailand have yet to ratify the CTBT. The ASEAN countries are also members of the South-East Asia Nuclear-Weapons-Free Zone (Treaty of Bangkok), which itself prohibits nuclear tests. Full regional membership of the Treaty of Bangkok and the CTBT are important steps in establishing South-East Asia as a nuclear weapon-free bastion of stability. In the wider region, the only countries that have yet to ratify the CTBT are Papua New Guinea, Timor-Leste, Nepal, and my own country, Sri Lanka. Taking this decisive step would put the nuclear weapon possessors and the remaining eight CTBT hold-outs in the spotlight.

All these countries are parties to the Nuclear Non-Proliferation Treaty as non-nuclear weapon States and active members of the Non-Aligned Movement (NAM). For NAM, nuclear disarmament has been a core value since its inception in 1961. Over the decades it has pushed incessantly, and vigorously, for a global ban on nuclear weapons and nuclear tests alike and has supported the CTBT.

Ratifying the CTBT is not only a matter of principle. It is not only about supporting world peace and the environment. It is in our security interests. Indonesia has shown the way — now it is up to other countries to follow suit. Each additional ratification sends a clear political signal to the remaining hold-out States. The saga for the banning of all nuclear tests began in 1954 with a great visionary leader from Asia — Pandit Jawaharlal Nehru. It would be a tragic irony for Asian nations to be an obstacle now when that goal is within sight.

BIOGRAPHICAL NOTE

JAYANTHA DHANAPALA is a former United Nations Under-Secretary-General for Disarmament Affairs (1998-2003) and a former Ambassador of Sri Lanka to the USA (1995-7) and to the UN Office in Geneva (1984-87). 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 a member of several other advisory boards of international bodies.

An earlier version of this article was published in The Hindu *on 4 April 2012.*

Nuclear testing times

In India, membership of the CTBT is not on the agenda. But perhaps it's time to reconsider.

BY PRAMIT PAL CHAUDHURI
FOREIGN EDITOR OF HINDUSTAN TIMES

Foreign editor of Hindustan Times, Pramit Pal Chaudhuri, states that when New Delhi declared Pokhran II a complete success, this in effect indicated that India does not need to conduct more tests. In this case, India's current moratorium could be extended indefinitely and transmuted into a CTBT signature-cum-ratification.

The Comprehensive Nuclear-Test-Ban Treaty, an international agreement that would bind all nations to never again carry out a nuclear test, has passed from the lexicon of India's foreign policy debate – even though it used to be one of the most frequent disparagements in New Delhi's strategic circles.

In February this year, I attended a conference in Vienna, Austria, on *The Comprehensive Nuclear -Test-Ban Treaty (CTBT) at 15: Status and Prospects* as well as the anniversary celebrations of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). This invitation possibly arose because no Indian official was willing to attend. New Delhi has put so much space between itself and the CTBT that it even declines from sending observers to CTBTO functions. Other non-parties did attend, however, as diplomats from China and Pakistan were present at the conference.

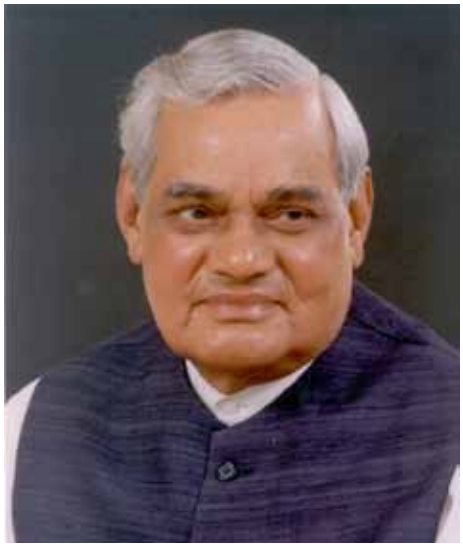
PREVENTING THE DEVELOPMENT OF NEW NUCLEAR WEAPONS

It was a useful refresher on where the CTBT stands today. My conclusion, reinforced by the conference and the anniversary celebrations, was that the Treaty is in remarkably good stead. It is also in a much better position to respond to a number of the criticisms that have been levied against the agreement in the past.

One is the issue of whether the CTBTO can actually detect a nuclear explosive. The answer is, largely, "Yes." The CTBTO today has an impressive network of international monitoring stations in a range of locations from the Arctic to the Antarctica, on mountaintops and deserts and even the ocean bed. Of the 337 facilities envisaged under the Treaty, over 80 percent are already fully operational and transmitting data to the CTBTO. These stations are of four varieties: seismic, hydroacoustic, radionuclide and infrasound. I visited an example of the third variety on the roof of the CTBTO's headquarters in Vienna, complete with its pure germanium detector and giant rooftop air-sampling vacuum cleaner.

There are some types of tiny nuclear tests, in the range of one-tenth of a tonne of TNT equivalent and less, that this network would struggle to detect. However, there are some who believe that such tests could help finesse existing weapons systems, but would be useless in the development of new ones. The CTBT is designed to constrain both the development and qualitative improvement of nuclear weapons.

The other issue is whether the Treaty is ever likely to get the approval of the main nuclear powers. The answer: it all depends on the United States' presidential elections in November.


From left to right: Prime Minister of India, Manmohan Singh; former Prime Minister of India, Atul Bihari Vajpayee; and K. Santhanam, formerly of the Defence Research Development Organisation. They have all participated in the debate on nuclear testing in India. According to Chaudhuri: "What is noteworthy is that the two most marginal groups, the ultranationalists and the left, are the only schools strictly opposed to signing the CTBT under any circumstances."

THE NUCLEAR NON-PROLIFERATION DOMINO EFFECT

As the conference made amply clear, until the US ratifies the CTBT, China will not do so. And if neither of them ratifies, then India won't either. If India is on board, so is Pakistan. Israel, one of the quiet nuclear weapons possessing States, would probably go in once the US does. This is the nuclear non-proliferation domino effect.

This chain reaction of ratifications and signatures is expected to follow a US action. In India's case the two acts are merged into one as adherence to an international treaty is an executive privilege, not requiring legislative sanction. This fact I realized in Vienna is not widely understood even among many non-proliferation advocates, resulting in the criticism that New Delhi has 'not even' signed the CTBT unlike, say, the United States and China.

What has happened since the CTBT came into effect, however, is that almost every country in the world accepts the norm that there should be no testing.

India, of course, famously refused to sign the CTBT when it opened for signature on 24 September 1996, and subsequently carried out a set of nuclear tests in 1998. Despite attempts by the government of Prime Minister Atul Bihari Vajpayee and his successor, Manmohan Singh, to consider putting pen to dotted line, they have been put off by strong political and intellectual opposition that has been able to recast adherence to a test ban as a "loss of sovereignty" issue – or worse.

INDIA'S FOUR SCHOOLS OF FOREIGN POLICY

Using the formulations of Dr Kanti Bajpai, and its reformulation in Dr Henry Nau's soon to be released study on the foreign policies of emerging powers, it can be said there are four schools of foreign policy in India. Of these, the ultranationalists want more nuclear tests and remain wary of accepting any non-proliferation treaty obligations; the cautious pragmatists say ratify the Treaty after the United States and China; the left wing favour global zero – worldwide nuclear disarmament – and say the CTBT merely reinforces the monopoly of existing powers; and the neo-liberals, for whom this is about leverage for technology and status, and who are prepared to trade the right to test for either.

What is noteworthy is that the two most marginal groups, the ultranationalists and the left, are the only schools strictly opposed to signing the CTBT under any circumstances.

Prime Minister Singh has in recent times stated in public and in private that the situation regarding India's stand on the CTBT will "change" after the US and China have led the way. It all depends on whether India actually needs to carry out more nuclear tests.

Opinion is divided, but a 2009 debate on this issue was triggered by K. Santhanam, the former number two at the Defence Research Development Organisation, who claimed that the Pokhran II nuclear tests had failed and that, in particular, India did not have a credible hydrogen bomb capacity. In the resulting furore, the government released more information about the tests and made a strong case for the tests having succeeded.

In its defence, New Delhi had the then Chairman of the Atomic Energy Commission, Dr Anil Kakodkar, publicly say in September 2009: "We want to re-emphasise that the 1998 tests were fully successful and had achieved in toto their scientific objectives and the capability to build fission and thermonuclear weapons with yields up to 200 kilotonnes."

NO NEED FOR INDIA TO CONDUCT FURTHER NUCLEAR TESTS

By declaring Pokhran II a complete success, New Delhi in effect indicated it does not need further tests. In this case, India's existing moratorium on further

Former Chairman of the Atomic Energy Commission of India, Anil Kakodkar said in September 2009 "We want to re-emphasise that the 1998 tests were fully successful and had achieved in toto their scientific objectives and the capability to build fission and thermonuclear weapons with yields up to 200 kilotonnes."

» There are also a number of other reasons why India should take another look at the CTBT. In India, the Treaty's civil and scientific applications are largely unknown.«

nuclear tests can be extended indefinitely and, if so, might well be transmuted into a Treaty signature-cum-ratification.

It is possible New Delhi could keep CTBTO membership as a negotiating chip, keeping it on hold until it becomes a member of the Nuclear Suppliers Group and other non-proliferation technology control regimes. But this is a tactical issue. Non-membership of the CTBTO would not be in foreign policy interests or an ideological stance.

Over the last two years, there has been a remarkable paralysis within the Indian polity. Prime Minister Singh's ruling coalition has become increasingly unruly, the Indian economy has experienced a slowing growth rate and high inflation, and anti-incumbency runs between 30 to 50 percent in legislative elections. This has led the political class to become extremely risk-averse, avoiding issues that are even remotely sensitive. By the middle of 2012, there were an estimated 180 pieces of legislation stuck in the Indian Parliament.

As a consequence, it is perfectly possible that even if the US and China do ratify the Treaty, India would not necessarily be the first off the block among the remaining nuclear powers to join the CTBT. This would not be a result of opposition to a test ban *per se* but rather because political circumstances would place it low on the priority list.

THE CTBT OFFERS A RANGE OF CIVIL AND SCIENTIFIC APPLICATIONS

There are also a number of other reasons why India should take another look at the CTBT. In India, the Treaty's civil and scientific applications are largely unknown. That its network of monitoring sites allowed the CTBTO to play a remarkable role in detecting and tracking the consequences of the March 2011 Fukushima Dai-ichi nuclear accident in Japan has received little notice in India.

Similarly, there is little awareness in India that CTBTO data can be used to monitor tsunami-type geological activity and to help tsunami warning centres issue timely alerts. This was the case when Japan suffered the 9.0 magnitude earthquake that led to the destruction of the Fukushima Dai-ichi nuclear power plant reactor. Tokyo confirmed that CTBTO data had helped them to send out tsunami warnings within a few minutes, allowing many people to escape to higher ground.

India, which saw a surge in anti-nuclear protests on its home soil after the Fukushima accident, has been much more conscious about tsunamis since the 2004 Indian Ocean tsunami which killed an estimated 18,000 Indians.

While New Delhi is waiting for the US Senate to get the CTBT ball rolling again, it can afford to bring an end to its present Cold War-derived allergy to the CTBTO and similar bodies.

Pakistan is a CTBTO observer State even though it has not signed the Treaty. The US and China – both CTBT signatory States but who have yet to ratify the Treaty – participate fully in the work of the organization. India could therefore easily be an observer of the CTBTO without compromising any of its principles.

BIOGRAPHICAL NOTES

PRAMIT PAL CHAUDHURI is the Foreign Editor of *Hindustan Times* and has been with the paper since 2000. He wrote about international politics and economic issues for *The Telegraph* and *The Statesman* newspapers in Calcutta from 1985 to 2000.
In 2011, he was appointed to the National Security Advisory Board to the Prime Minister of India for a two-year term.
Mr Chaudhuri also serves as a delegate for a number of strategic and economic dialogues on behalf of the Confederation of Indian Industries and the affiliated Aspen Institute of India.

An earlier version of this article was published in Hindustan Times *on 2 March 2012.*

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

AROUND THE GLOBE AND AROUND THE CLOCK: THE SCIENCE AND TECHNOLOGY OF THE CTBT

12 - 23 November 2012

The CTBTO's Capacity Development Initiative (CDI) aims to attract and train the next generation of experts in all legal, political, technical and scientific aspects of the Treaty and its verification regime. Its courses, which can be taken in person or via e-learning tools, are designed to build capacity at the national, regional and international levels.

The next course, in Advanced Science, takes place from 12-23 November 2012. It will take an in-depth look at verification technologies and will include lectures by a number of eminent scientists .

register online at ctbto.org/cdi

cdi capacity development initiative

Training and educating the next generation of CTBT experts

VOICES

Disarmament and non-proliferation education

Recent developments and the way forward

BY ELENA K. SOKOVA,
EXECUTIVE DIRECTOR,
VIENNA CENTER FOR DISARMAMENT
AND NON-PROLIFERATION

Even though the 2002 UN resolution on non-proliferation education received wide support, its implementation in the form of specific programmes lags behind, writes Elena Sokova from the Vienna Center for Disarmament and Non-Proliferation. A growing interest in nuclear issues combined with the desire for a strengthened mandate reinforce her belief that high-quality disarmament and non-proliferation education should be comprehensive, sustainable, and truly global.

The overall aim of disarmament and non-proliferation education is to equip individuals with the knowledge and skills necessary to allow them to work towards the achievement of enhanced national and international security at lower levels of arms and ultimately general and complete disarmament under effective international control. The empowering role of education in promoting and advancing disarmament has been recognized since the first special session of the United Nations General Assembly on disarmament issues in 1978.

In 2002, the UN General Assembly (resolution 57/60) endorsed the UN Secretary-General's Report on Disarmament and Non-proliferation Education (A57/124), which contained 34 specific recommendations aimed at the promotion and implementation of the disarmament and non-proliferation curricula at various levels of education. While the resolution received wide support, its implementation has been lagging behind. For example, only nine member states submitted their reports in 2012.

Several developments over the past two years, however, indicate enhanced interest in the area of disarmament and non-proliferation education, particularly in the nuclear sphere, and give hope that this interest could to be sustained and expanded.

In April 2010, the Nuclear Security Summit in Washington DC in its communiqué and work plan noted the importance of education and training in strengthening nuclear security. In May 2010, the Review Conference of the Nuclear Non-Proliferation Treaty (NPT) in its Action Item 22, called on member states to fully implement the recommendations of the 2002 study (A57/124) and acknowledged the role of education in achieving a world without nuclear weapons. A range of new educational initiatives to promote a nuclear-weapon-free world were also launched in 2010-2011, spanning a broad spectrum of efforts by international organizations, academic institutions and think tanks.

»Disarmament and non-proliferation issues should become much more prominent in academic institutions, both in undergraduate and graduate schools. «

In March 2010, a group of universities, research centres and other educational organizations gathered in Vienna to formalize the creation of a network to promote nuclear security education. The International Nuclear Security Education Network (INSEN) was established under the auspices of

the International Atomic Energy Agency (IAEA) and now includes over 60 universities from all geographic regions. Members of the network jointly develop teaching materials and programmes, update each other on their academic and extra-curricular programmes, and share best practices and resources.

The launch of the Capacity Development Initiative (CDI) by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in 2011 is another major contribution to educational and training efforts in the nuclear disarmament sphere. A series of introductory and advanced level courses held in Vienna have covered the political, legal, technical and scientific aspects of the Treaty and its associated verification regime. The CDI is a timely and welcome development in strengthening capacities at the national, regional and international level to ensure full implementation and verification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and to further promote arms control and disarmament values and norms. It is also gratifying to see that the CDI's courses are designed to reach hundreds, if not thousands, of students and professionals by supplementing in-class instruction with on-line streaming and other e-learning tools and by employing the train-the-trainer approach.

A GROWING INTEREST IN NUCLEAR ISSUES

Several academic degree programmes on nuclear non-proliferation, nuclear security, and similar issues have also been launched over the past two years, including Masters-level degree programmes at King's College in the UK, the Monterey Institute of International Studies in the USA, and Tomsk Polytechnic University in Russia. Over a dozen prominent universities added new courses in this area and plan to introduce certificate and full Masters programmes. These include a consortium of six European universities that have agreed to allow students to transfer relevant academic credits from one school to another.

Interest in nuclear disarmament and non-proliferation among students and young scholars continues to grow and is reflected in the enrollment numbers and the proactive role the new generation plays in promoting these issues. Of particular interest was the establishment in November 2010 in Vienna of a global network of young scholars and practitioners —the International Network of Emerging Nuclear Specialists (INENS), which unites professionals with policy and technical backgrounds from many countries and continents.

ENSURING THE SUSTAINABILITY OF DISARMAMENT AND NON-PROLIFERATION EDUCATION

These 2010-2012 developments are extremely important, but they should not be taken as a signal that the global community can pat itself on the back and declare 'mission accomplished'. On the contrary, the momentum created by both the recognition of the importance of the issue at the highest government level and the headway in various academic and professional development programmes, are only the initial steps in making high-quality disarmament and non-proliferation education comprehensive, sustainable, and truly global.

Disarmament and non-proliferation issues should become much more prominent in academic institutions, both in undergraduate and graduate schools. Despite the increase in the last decade of such programmes and courses at several universities, these issues are still far from being part of the regular curriculum in the fields of humanities and sciences. The availability of dedicated disarmament and non-proliferation programmes and courses falls short of demand and needs, particularly when geographical factors are taken into account. In many countries, including

Over 450 participants from 91 countries attended the CTBTO's Capacity Development Initiative Intensive Policy Course in Vienna, Austria, from 16 to 20 July 2012.

»Education is truly a key building block on the path to peace and security.«

those with strong historical support for disarmament, the number of scholars and faculties teaching these issues is usually in low single digits, if not zero.

The shortage of knowledgeable government experts and practitioners in the area of arms control and disarmament, however, cannot be changed through academic coursework alone. Professional development and other training activities are another necessary component of this multifaceted approach. A true partnership between academic and professional development programmes is also required. In this respect, the developing partnership between the CTBTO's CDI and a number of universities that allow transfer of academic credits for CDI courses, is a step in the right direction and should be strengthened further.

IMPORTANCE OF A COMPREHENSIVE DISARMAMENT CURRICULUM

As some of the already existing programmes prove, disarmament and non-proliferation education should embrace various aspects related to the subject, including policy, history, science and technology, social and legal issues. It does not mean that all of these issues need to be equally addressed. The right balance would depend on the main focus of the programme and its audience. However, it is very important that technical specialists are exposed to policy issues and it is similarly important for those studying social science to be aware of key technical concepts underpinning policy decisions.

The recent progress in academic and training courses with a focus on nuclear issues, particularly in the area of nuclear non-proliferation, verification technologies, and security of nuclear materials, needs to be matched with programmes that have a more robust focus on nuclear arms control and disarmament issues. Other weapons, including chemical, biological, and conventional arms, also need to be part of the comprehensive disarmament and non-proliferation curriculum.

CAPACITY-BUILDING AT THE NATIONAL, REGIONAL AND INTERNATIONAL LEVEL

The capacity and capabilities for offering academic and professional development programmes differ considerably across the globe, particularly in developing countries. Countries and organizations with expertise and resources should make a concerted effort to extend their programmes to regions that are lacking them. Wherever possible, representatives from developing countries, including women, should be encouraged to participate, and young people should have the opportunity to be engaged.

Experts in arms control and disarmament with first-hand experience, however, are in short supply in both developing and developed countries, including nuclear weapon States. The old generation of scholars and practitioners increasingly complain that very few younger experts are coming to replace them. To an extent, this void developed after the end of the Cold War, when many colleges and universities stopped focusing on these issues as the possibility of a nuclear exchange between East and West was no longer imminent. Efforts focusing on training the trainers, particularly for university professors and other instructors, could remedy this situation. These programmes have a multiplier effect and are crucial for building national and regional capacities and for ensuring the sustainability of these efforts.

A LASTING COMMITMENT AND THE NEXT STEPS

Former UN Secretary-General Kofi Annan's words that "education is quite simply, peace-building by another name" are not just a catchy phrase. Education is truly a key building block on the path to peace and security. However, the impact of education is sometimes not immediately obvious or easily measurable. To make a lasting difference, various educational and training activities require substantial, long-term commitment and investment.

A number of measures could be undertaken to secure such a commitment. For example, the role of the United Nations and its Office for Disarmament Affairs should be strengthened, particularly with regards to the promotion of education and capacity building among Member States and regional organizations, as well as the coordination of existing efforts by various UN bodies and other international organizations.

A strengthened mandate would:

- *Empower a more comprehensive approach to education*
- *Take advantage of complementary programmes across a variety of governmental and non-governmental efforts*
- *Help avoid gaps*
- *Bring additional much needed attention and resources*

In this regard, it might be desirable to establish an international disarmament and non-proliferation education fund under the auspices of the UN to ensure that substantial resources are made available on a continuous basis, particularly for regions in need.

It might also be helpful to appoint a prominent international figure to become a global disarmament and non-proliferation education ambassador, as well as increase the role of UN regional offices in advancing this agenda. Other measures to raise the salience of the issues could also be explored. The moment is ripe, and the international community should take full advantage of the momentum created over the past two years.

BIOGRAPHICAL NOTE

ELENA SOKOVA
is the Executive Director of the Vienna Center for Disarmament and Non-Proliferation. Prior to coming to Vienna in June 2011, she worked for 14 years at the James Martin Center for Nonproliferation Studies, Monterey Institute of International Studies, a graduate school of Middlebury College (USA). From 1981 to 1992 she worked at the Ministry of Foreign Affairs of the USSR/Russian Federation.

A winning gambit

Nuclear armed States stand to gain more than they lose from CTBT ratification

BY SIEGFRIED S. HECKER,
FORMER DIRECTOR OF THE LOS ALAMOS NATIONAL LABORATORY

Countries tested nuclear weapons for technical, political and military reasons. Even though Siegfried Hecker, former Director of the Los Alamos National Laboratory, mentions the positive aspects of nuclear testing, he also explains why it is critical to erect as many barriers as possible to prevent the resumption of testing, the most important barrier being the CTBT's entry into force.

During the Cold War, nuclear testing played a crucial role in increasing the sophistication of nuclear weapons. As nuclear weapons became smaller, delivery methods moved from planes to ships and eventually to missiles.

I believe that countries tested for technical, military and political reasons.

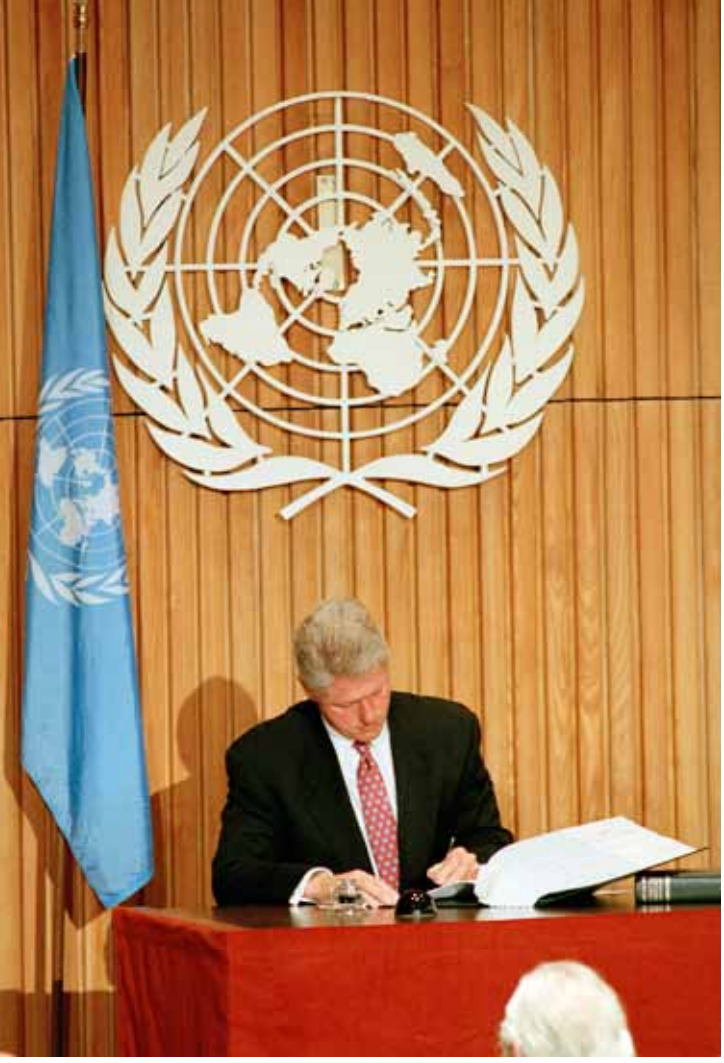
DEMONSTRATING TECHNICAL CAPABILITIES CAN MAKE THE WORLD A MORE DANGEROUS PLACE

In the United States, the main reason for testing was unquestionably technical – we had to demonstrate that the plutonium bomb worked so we exploded the Trinity bomb in the New Mexico desert before a similar bomb was used at Nagasaki. We continued to test and to improve technologies for nuclear weapons. While I was Director of Los Alamos National Laboratory, the issues of ratifying the Threshold Test Ban Treaty and signing the Comprehensive Nuclear-Test-Ban Treaty (CTBT) came up. In 1995, President Bill Clinton and Secretary of Defense Bill Perry asked me to give a technical assessment of the need for testing.

The question posed by the Chairman of the Joint Chiefs of Staff, General John Shalikashvili, on behalf of President Clinton and Secretary Perry, was whether we needed to test to be able to certify the US nuclear stockpile. I replied that our weapons were safe, secure and reliable and since US policy was not to field weapons with new capabilities, I could not say that we had to test to keep them that way. But, I could not guarantee that they would remain so over time, so they would have to ask us (the directors of the nuclear weapons laboratories with the technical responsibility for the US arsenal) as the weapons aged or were replaced.

President Clinton signed the CTBT in 1996 and instituted an annual certification process, which requires the laboratory directors to assess the safety, security and reliability of the nuclear stockpile without nuclear testing. The directors of the Los Alamos and Lawrence Livermore national laboratories have continued to certify the US stockpile as safe, secure and reliable without nuclear testing since 1996.

For nuclear weapons, as for any other sophisticated technology, testing had been an indispensable tool for scientific and technological advancement during the Cold War. Over the years, nuclear testing had



President Bill Clinton signing the Comprehensive Nuclear-Test-Ban Treaty on 24 September 1996.

»For the United States, it is primarily international norms that constrain it from testing. There is a strong desire by some to have the United States lead the international non-proliferation regime. Unfortunately, that's not what Washington has done by failing to ratify the CTBT.«

not only allowed for greater sophistication of weapons, but it had also helped to assure the safety, security and reliability of the nuclear arsenal.

The Soviet Union, France and China also tested for technical reasons. France conducted a significant number of tests for the size of its arsenal – 204 tests by 1992. President Chirac announced in June 1995 that France would carry out eight more tests in the Pacific before pulling out of the area and signing the CTBT. The French justified the tests on the grounds that they wanted to make their arsenal safer and more robust. Technical progress and international pressure limited the number of tests in that campaign to six. The Chinese also continued testing for reasons of safety and the need to modernize their arsenal. They completed a test series and signed the CTBT in 1996.

In 1998, the world became a more dangerous place when India and Pakistan conducted nuclear tests to declare their nuclear power status. After an interlude of 24 years since its 'peaceful' nuclear explosion in 1974, India tested three devices on 11 May 1998, followed by another two on 13 May. Pakistan retaliated within two weeks with six tests of its own in two separate testing events.

Although the Indian and Pakistani tests demonstrated that their nuclear weapons programmes, both decades in the making, produced functioning nuclear devices, the tests must also have raised many more technical questions. It is common testing practice to stage the timing of tests to allow the results of one to inform the design of the next. This was not the case for India and Pakistan because the five Indian tests in 1998 were conducted almost simultaneously, as were all six Pakistani tests. In nuclear testing, as in most technological ventures, there is always something that doesn't work the way you intended, no matter how good the computers are or how many laboratory tests have been conducted. The Indian and Pakistani test experiences did not allow for learning from one test to guide the design of the next. Hence, there must be strong technical drivers for them to test again.

For deterrence to work, nuclear weapons must be effective. A lot of testing was carried out for military reasons during the Cold War, especially during the first 20 years. The military needs to gain confidence in the technical community and testing demonstrates a country's nuclear capability. That was the case for the United States and the Soviet Union. They performed many tests and possessed huge nuclear arsenals. The Chinese have a different philosophy: they believe in minimal nuclear deterrence and, hence, are believed to have a small arsenal. North Korea claims it built nuclear weapons as a deterrent, primarily against the United States. However, during my discussions with North Korean authorities in Pyongyang I found little consideration of how they would actually use their nuclear weapons, nor did they seem well versed on the issues of safety and security of nuclear weapons or military posture.

MAKING A 'POLITICAL STATEMENT' WITH NUCLEAR TESTS

The bombs that the United States dropped on Hiroshima and Nagasaki in August 1945 were not only supposed to end the war with Japan but also to send a signal to the Soviet Union. When the Soviets detonated the 'Tsar Bomba' over Novaya Zemlya on 30 October 1961, they were also making a powerful statement. The bomb was designed for 100-plus megatons but the Soviet designer, physicist Andrei Sakharov, persuaded Soviet leader Nikita Khrushchev to test it at half yield. Yuri Trutnev, the co-designer of the 'Tsar Bomba,' explained to me (years later) that the bomb had no military significance but it was exploded to send a message to the rest of the world, i.e. that they were capable of developing a bomb at any level. It is

difficult to imagine the destructive power of a 100-megaton bomb – that's equivalent to 5,000 Nagasaki bombs!

France also tested for political reasons, particularly during the days of President Charles de Gaulle. China had political grounds, to some extent. Political reasons include declaring a country's nuclear status, which was the case for India, and to some extent Pakistan and North Korea. India tested in two phases – first in 1974; what they called a 'peaceful' nuclear explosion. So, it was clearly not strictly driven by national security concerns. Then in 1998, when security was a somewhat greater issue, but I believe the main driving force was domestic politics. Pakistan was obviously concerned about its security because of India: once India tested, Pakistan felt that it had to test as well, making South Asia one of the most dangerous areas in the world. The 1998 tests and the North Korean tests in 2006 and 2009 did significant damage to the international security regime.

North Korea's nuclear programme was principally driven by national security, but the 2006 test changed everything, particularly how North Korea looked at itself: Pyongyang began to use its self-declared nuclear power status as an international bargaining tool that helped keep the regime in power. In addition, once it tested, the bomb took on domestic importance. It was used to underscore the great danger Pyongyang faces and the need for its people to continue their sacrifices to fend off these dangers. Now for all three reasons – security, making an international statement and domestic reasons – it will be difficult to get North Korea to give up its nuclear weapons. The international community powers must convince Pyongyang that it would be better off without testing and without a nuclear arsenal.

THE PERILS OF THE DISSOLUTION OF THE SOVIET UNION AND THE RISE OF THE 'NUCLEAR WALMART'

I became Director of the Los Alamos National Laboratory shortly after Mikhail Gorbachev came to power in the Soviet Union in 1985. My personal focus changed from technical work in materials science and plutonium metallurgy and being preoccupied with deterring the Soviet Union, to trying to understand how the world's nuclear threats were changing. The immediate danger at that time was the unstable situation in Russia: the country was going through political, economic and societal turmoil while possessing an enormous amount of nuclear materials and a huge nuclear arsenal. Much of my work over the last 20 years has focused on helping the Russian nuclear complex deal with these challenges.

In the late 1990s we were confronted with the additional danger posed by A.Q. Khan and a number of European businessmen who set up the 'Nuclear Walmart', a proliferation network, which involved selling to aspiring nuclear powers the components to make and enrich uranium or to build their own reactor. They also sold nuclear device design data and nuclear test data, making it even more dangerous.

The world changed again with the events of 9/11. Over the last decade or so, the key international nuclear challenges have been those associated with horizontal proliferation and nuclear terrorism.

Siegfried Hecker, third from right, visiting the Yongbyon Scientific Nuclear Research Center, North Korea, August 2007.

"The international community powers must convince Pyongyang that it would be better off without testing and without a nuclear arsenal," urges Hecker in his article.

World view of former and inactive nuclear test sites.

In Hecker's words: "The CTBT constrains nuclear weapons development and the sophistication of nuclear arsenals. It also reduces the risk of a renewed arms race, especially between India and Pakistan."

WHY TEST NOW OR IN THE FUTURE?

From the American perspective, the focus since 1992, when we conducted our last nuclear test, has been on the safety and reliability of the country's nuclear weapons. I was in Washington when President George H.W. Bush announced the nuclear testing moratorium in 1992. When I returned to Los Alamos I told my technical people: "Testing is over. It will be our responsibility to assure the nation that our weapons are safe, secure and reliable without testing. How are we going to do that?" This continues to be the focus today. The weapons must continue to be safe. They must also be more secure since we now face a level of international terrorist threat unimaginable before 9/11.

Some people claim that we do not need to test because of the enormous advances in computing power and the fact we have acquired a better fundamental understanding of how weapons work through what we call the Stockpile Stewardship Program (SSP). I disagree with those who say we lose nothing by not testing. There are benefits to nuclear testing, just like in any technological enterprise. Testing represents the ground truth; it keeps the technical experts honest. However, nuclear testing also incurs a cost and the real question is whether or not the costs are greater than the benefits.

WHAT CONSTRAINS NUCLEAR TESTING?

To understand the benefits and costs of nuclear testing, we must understand why countries would want to test and what constrains them from doing so. I have already pointed out that there are technical, military and political reasons for testing. For the United States and Russia, with their huge nuclear arsenals, a return to testing would primarily be directed at keeping those arsenals safe, secure and reliable. For China, India, Pakistan, and North Korea there would also be strong drivers to test to enhance the sophistication of their arsenals. France and the UK are similar to the United States and Russia.

What constrains countries from testing are international norms, domestic pressures, and technical or financial factors. For the United States, it is primarily international norms that constrain it from testing. There is a strong desire by some to have the United States lead the international non-proliferation regime. Unfortunately, that's not what Washington has done by failing to ratify the CTBT. For the United States there is also significant domestic pressure against testing and there are some financial constraints because it has become so expensive to test.

In Russia, the only constraints I see are international norms and pressures – the same applies for China. The UK and France also have technical constraints because they have no nuclear test site. Israel, of course, is a special case, but it is subject to similar constraints as the UK and France. India and Pakistan have kept the testing option open while observing the moratorium. India has international and domestic constraints, whereas I believe that international pressure is the only thing that prevents Pakistan from testing again. And pressure from China has had some, albeit limited, effect on North Korea.

For North Korea the main technical constraint is the lack of bomb fuel. They only have between 24 and 42 kg of plutonium, which is enough to make between four and eight bombs. There's no plutonium in the pipeline because their plutonium production reactor was shut down in 2007 and has not been restarted. We don't know exactly where

they are with regard to highly enriched uranium but that presents significant additional problems in terms of testing. When I was in North Korea in November 2010, Pyongyang revealed its uranium enrichment facility during my visit to the Yongbyon nuclear complex. Prior to this time, I had assumed that the uranium enrichment programme was at a research and development scale, but what they showed me was far greater and much more sophisticated. It is imperative that the North Koreans don't build more bombs or test again to build more sophisticated weapons.

BENEFITS OF THE CTBT

The CTBT constrains nuclear weapons development and the sophistication of nuclear arsenals. It also reduces the risk of a renewed arms race, especially between India and Pakistan. The Treaty supports the nuclear non-proliferation regime and is consistent with Article VI of the Nuclear Non-Proliferation Treaty (NPT) and the eventual elimination of nuclear weapons. And although the health and ecological effects of testing are more limited today than during the days of atmospheric testing, the CTBT limits potential radioactive leakage from underground tests.

THE VERIFICATION ISSUE AND THE DEFINITION OF 'ZERO YIELD'

Great progress has been made in CTBT verification technologies and protocols. Nevertheless, there are critics who contend that low-yield, decoupled explosions cannot be detected. So, the issue is how proper protocols can be implemented and how to determine the military significance of such low-yield explosions, if such tests are conducted.

In the United States there will definitely be considerable focus on the definition of 'zero yield'. What does it really mean to have no nuclear testing? I believe it comes back to the issue of what is militarily significant. There is particularly great concern in the United States about potential asymmetries in how Russia and China define nuclear testing and zero yield. Nevertheless, I believe that we have adequate verification capabilities today and that we can build in sufficient safeguards and verification measures to make the Treaty adequately verifiable.

IN THE END, THE BENEFITS OF THE CTBT OUTWEIGH THE RISKS

As I pointed out, the CTBT poses challenges for nuclear armed States to keep their arsenals safe, secure, and reliable as long as they possess nuclear weapons. The technical risks of not testing must be mitigated by other means; for example, a robust SSP that leads to a better fundamental understanding of nuclear weapons and an extensive stockpile surveillance programme to assess and understand aging-induced changes in the stockpile. Likewise, a country's nuclear weapons policies influence the risks of a CTBT. In the United States, for example, the policy of not developing nuclear weapons with new capabilities greatly reduces the technical risks incurred by a CTBT. During the Cold War, testing was necessary to meet the government's drive to continually upgrade the arsenal to counter the perceived Soviet threat. It was also used to explore entirely new weapons concepts and potential vulnerabilities.

As already pointed out, not testing greatly constrains the ability of a country to build more sophisticated nuclear arsenals and, consequently, it reduces the risk of an arms race. Therefore, it is critical to erect as many barriers as possible to the resumption of testing. Ratification of the CTBT and its entry into force is the most important such barrier. We should not settle for the current moratorium on nuclear testing. In addition to these global benefits, each of the States possessing nuclear weapons, in my opinion, has much to gain from a comprehensive test ban.

The United States and Russia have conducted 1,054 and 715 nuclear tests, respectively. Along with France and the UK, they benefit greatly by not having China test since it has conducted only 45 tests. China benefits because India, with only six nuclear tests, will not be able to enhance its arsenal significantly. India benefits by constraining Pakistan, which has also only conducted six tests, and appears to be readying plutonium-based tactical nuclear weapons for its arsenal. Pakistan benefits by India not being able to increase the sophistication of its weapons. The testing moratorium by the major nuclear countries did not stop Pyongyang from testing and it may not be a decisive factor in Tehran's decision as to whether it may test in the future. However, the increased international pressure of a ratified CTBT may increase the effectiveness of international constraints and possibly affect their decision. Regardless, I believe the States possessing nuclear weapons today have more to gain by CTBT ratification and entry into force than they lose by not testing.

CTBTO FACES INTERVIEW

In September 2011, while in Vienna to lecture at the CTBT Introductory Course, Siegfried Hecker gave an in-depth interview in which he discussed his views on the benefits, and the challenges, of ending nuclear testing

To watch the interview point your browser to: **ctbto.org/faces**

BIOGRAPHICAL NOTE

SIEGFRIED S. HECKER
is director emeritus at the Los Alamos National Laboratory, where he served as director from 1986 to 1997 and senior fellow until July 2005.
He is currently engaged as research professor in the Department of Management and Engineering at Stanford University, senior fellow at the Freeman Spogli Institute for International Studies, and co-director of the Stanford University Centre for International Security and Cooperation.

This article is loosely based on a presentation Dr Hecker made at the CTBT Introductory Course in Vienna in September 2011.

The Fukushima nuclear accident

Lessons learned and possible implications

BY TATSUJIRO SUZUKI
VICE CHAIRMAN
JAPAN ATOMIC ENERGY COMMISSION

How can we control nuclear weapons if we cannot control nuclear energy, asks Tatsujiro Suzuki of the Japan Atomic Energy Commission in his article. Highlighting the main points raised by the Japanese government investigation committee and the independent investigation committee, Suzuki provides an invaluable insight into the Fukushima accident in March 2011.

The Tohoku District-off the Pacific Ocean Earthquake and the resulting tsunamis struck the Fukushima Dai-ichi and Fukushima Dai-ni Nuclear Power Stations of Tokyo Electric Power Co. (TEPCO) at 14:46[1] on 11 March 2011. A nuclear accident unprecedented in both scale and timeframe followed. Since then this has become an historic day to remember for all nuclear experts not only in Japan but also in the rest of the world.

More than 17 months have passed but the accident is not completely over. More than 100,000 residents in Fukushima are still living in temporary housing due to the evacuation that took place after the accident and are still uncertain as to when they can return to their original hometowns. Although conditions at the Fukushima power stations have improved, it will take more than 30 years to remove melted fuel debris from the site. Still, we need to draw lessons based on the knowledge and information available so far to assure the safety of existing nuclear facilities and the possible implications this has for future nuclear energy policy.

Two important reports have been published, one by the government investigation committee (the Government committee)[2] and the other by the independent investigation commission (the Diet's commission)[3] set up by the Diet – Japan's Parliament. The following report is my personal observation based on the above reports and other publicly available information.

[1] All times herein are JST, which is nine hours ahead of UTC/GMT.
[2] Investigation Committee on the Accident at the Fukushima Nuclear Power Stations, Final Report Recommendations, July 2012
[3] The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), Final Report, July 2012.

PREVENTION OF THE ACCIDENT: 'A MAN-MADE DISASTER'

This point was particularly emphasized by the Diet's commission. It concludes that the accident was a 'man-made disaster', i.e. the accident would have been preventable if the operators and regulators had acted properly based on the information available to them. In particular, the most important fact quoted in the report by the Diet's commission was that both the operator, TEPCO, and the regulator, the Nuclear and Industrial Safety Agency (NISA), had been aware since 2006 of the risk that a total outage of electricity at the Fukushima Dai-ichi plant might pose if a tsunami were to reach the level of the site. The report also concluded that there were many opportunities for taking preventive measures prior to 11 March. However, TEPCO did not take the necessary measures and NISA and the Nuclear Safety Commission (NSC) were aware of this. Meanwhile, the report by the Government committee concluded that the scale of the tsunami was 'beyond [the] imagination' of TEPCO and regulators, and also said that their preventive measures were insufficient against tsunami and severe accident.

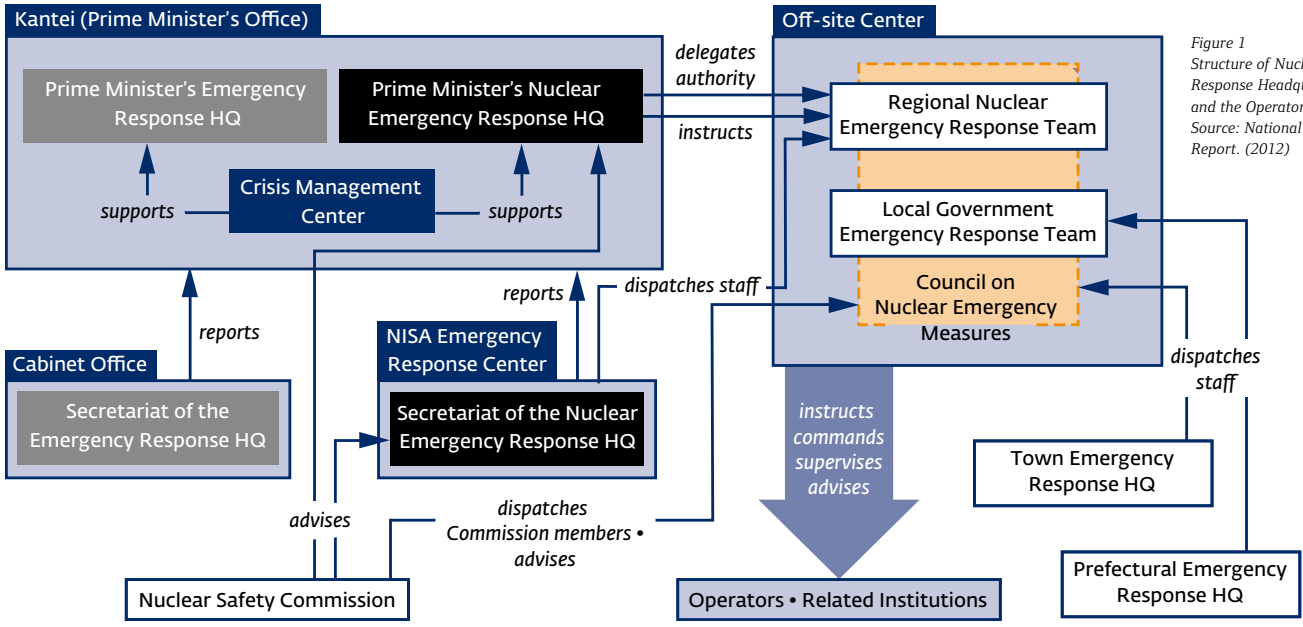


Figure 1
Structure of Nuclear Emergency Response Headquarter, Regulators, and the Operators
Source: National Diet Commission Report. (2012)

In short, the accident, although directly caused by an historic earthquake and tsunami, was preventable and thus it was a 'man-made accident'.

»In short, the accident, although directly caused by an historic earthquake and tsunami, was preventable and thus it was a "man-made accident."«

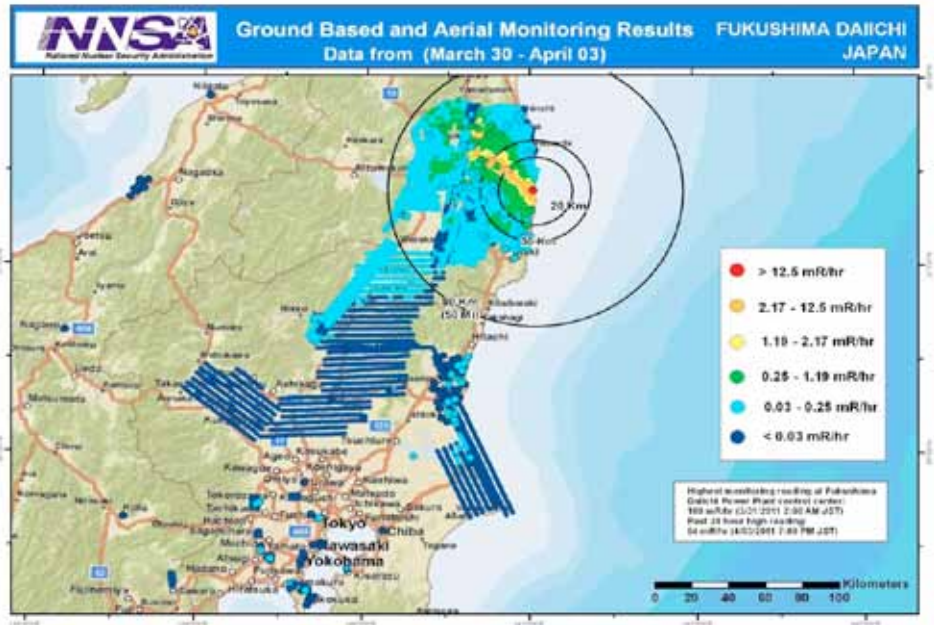
EMERGENCY RESPONSE: 'UNPREPARED'

Both the Government committee and the Diet's commission concluded that both TEPCO and the regulators were unprepared for a tsunami and a severe accident, as well as for a so-called 'multiple disaster' (i.e. a natural disaster such as a big earthquake and tsunami and a severe nuclear accident that happened subsequently, which could cause much worse consequences than a single disaster). For example, the off-site emergency centre, which was supposed to play a central role in sharing information and coordinating an emergency response, did not function due to a loss of power caused by the earthquake. All staff needed to evacuate the centre later due to high radiation levels. As a result, information sharing and coordination among key players did not work well. (Figure 1)

The Government committee stated in its interim report published in December 2011[3]:

> *"The Investigation Committee is convinced of the need of a paradigm shift in the basic principles of disaster prevention programs for such a huge system, whose failure may cause enormous damage."*

Both the Government committee and the Diet's commission concluded that, not only TEPCO and the regulators, but the central government,



Combined results of 211 flight hours of aerial monitoring operations and ground measurements made by DOE, DoD and Japanese monitoring teams.
Source: National Nuclear Security Administration (NNSA) US Department of Energy

[3] Investigation Committee on the Accident at the Fukushima Nuclear Power Stations, Interim Report, December 26, 2011

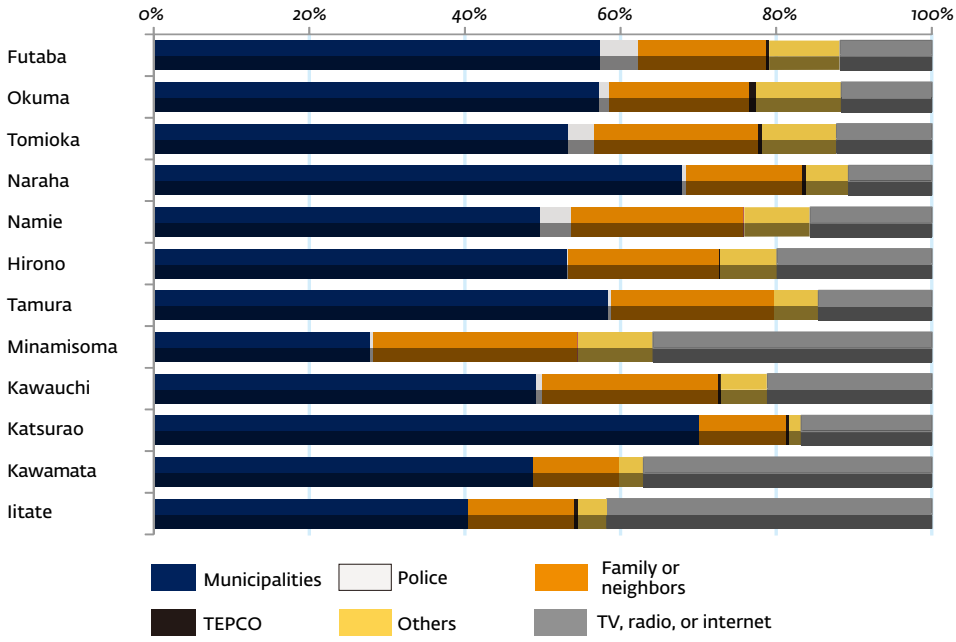


Figure 2
Sources of information about the evacuation instruction
Source: National Diet Commission Report. (2012)

in particular the Nuclear Emergency Response Headquarters (NERHQs) at the Prime Minister's office, was not prepared for a nuclear emergency. The Diet's commission concluded that the government, the regulators, TEPCO management and the Prime Minister's office lacked the preparation and the mindset to perform an emergency response. Miscommunication and mistrust among regulators, the Prime Minister's office and TEPCO were the result of poor crisis management by the government. The Government committee also recommended that the crisis management system for a nuclear disaster should be urgently reformed.

PROTECTING PUBLIC HEALTH: 'COMMUNICATION FAILURE'

Both the Government committee and the Diet's commission criticized the government for failing to communicate with the public in order to minimize the risk and concerns of the local population. In particular, both reports concluded that the government did not use the System for Prediction of Environmental Emergency Dose Information (SPEEDI) effectively. SPEEDI was intended to be utilized to inform the policy makers and the public which direction and how far the risk of radiation hazards might spread. The government noted that the SPEEDI data were not disclosed initially because they were not reliable and thus were not helpful for evacuation purposes. Unfortunately, however, communication failure on the radioactive release hindered the effective evacuation of the local public. (Figure 2) The Diet's commission concluded that the government and the regulator are not fully committed to protecting public health and safety. On this point, the Government committee recommended that nuclear operators and the regulators should establish a systematic activity to identify all risk potentials from the "disaster victims' standpoint".

REGULATORY FRAMEWORK: 'CAPTURED BY THE UTILITY INDUSTRY'

One of the most important conclusions of both reports was the deficiency of a regulatory framework. In particular, the Diet's commission stated that the regulator was 'captured' by the utility industry, i.e. the utility industry, through its Federation of Electric Power Companies (FEPC), guided and controlled the regulatory process to serve their interests. According to the Diet's commission:

> *"..they [operators and regulators] repeatedly avoided, compromised or postponed any course of action…The FEPC has been the main organization through which this intransigent position was maintained…In fact, it was a typical example of 'regulatory capture,' in which the oversight of the industry by regulators effectively ceases."*

As a result, the Japanese nuclear industry has fallen behind international standards in meeting the challenges of a tsunami and a severe accident. In short, they failed to keep up the global standard of the so-called five layers of 'defense in depth' strategy.

In order to reform this regulatory structure, both reports emphasized the importance of the "independence" and "transparency" for the newly established regulatory organization.

INTERNATIONAL DIMENSION: IMPORTANCE OF INFORMATION DISCLOSURE AND SHARING

Finally, the international dimension of the accident needs to be emphasized. In particular, information disclosure and sharing was considered insufficient, in particular with neighbouring countries. A

lack of adequate and timely information from Japan after the accident was cited as one of the reasons for increased concern about the risk of radiation. In this context, international monitoring of radioactive materials in the air and water can be very effective in providing an accurate picture of the consequences of the accident. In fact, the global network of radioactive monitoring stations established by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) was instrumental in reporting traces of radioactivity from the accident and sharing this information globally. Although the purpose of this network is to detect nuclear tests, monitoring radioactive materials (gases) in the air could be used to estimate the impact of serious nuclear accidents like Fukushima.

The Diet's committee recommended that "active and polite responses should be in place for prompt and accurate provision of relevant information with due consideration to language barriers." It also emphasized Japan's role as a provider of disaster-related information to Japan and the world. It further recommended that "the new regulatory organization must establish an organizational framework that enables it to provide information in a timely and appropriate manner during an emergency."

CONCLUSION: FROM FUKUSHIMA TO THE WORLD

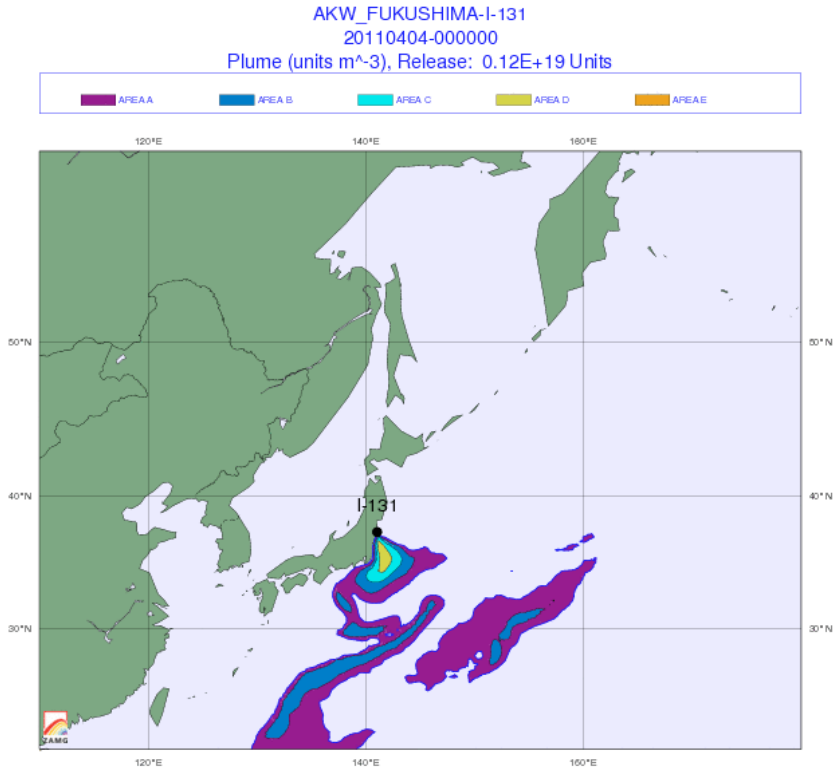
I would like to conclude with the following personal remarks.

First, we should be able to overcome this tragic accident with our wisdom. Yes, this is an unprecedented crisis, but a crisis can be an opportunity. We will draw lessons and come up with innovative ideas to improve the safety of nuclear power plants and to clean up the site. If we cannot control nuclear energy, how can we control nuclear weapons? We should overcome this man-made disaster with a humble attitude towards nature, science and technologies. I truly appreciate in this context that the international community can work together with Japan to overcome this crisis.

Second, let's make Fukushima a symbol of 'recovery'. Fukushima is now the victim of one of the most serious nuclear accidents in human history. But I sincerely believe Fukushima can become a symbol of 'recovery'. And this should be the goal of the Japanese Government and I will personally do my best to achieve this goal as a government official and as an individual.

Finally, in order to achieve the above two goals, I believe that the role of scientists can be extremely important. One of the important lessons we learned from the Fukushima accident is that closer collaboration between nuclear engineers/scientists and other fields of scientists, especially social scientists, is definitely needed to further improve the 'safety culture' of the nuclear community.

I sincerely hope that the lessons learned from the Fukushima accident can be shared by the global community and can be useful for improved safety and a better understanding of nuclear technology.



A regional dispersion simulation made by the Austrian Meteorological Service ZAMG

BIOGRAPHICAL NOTE

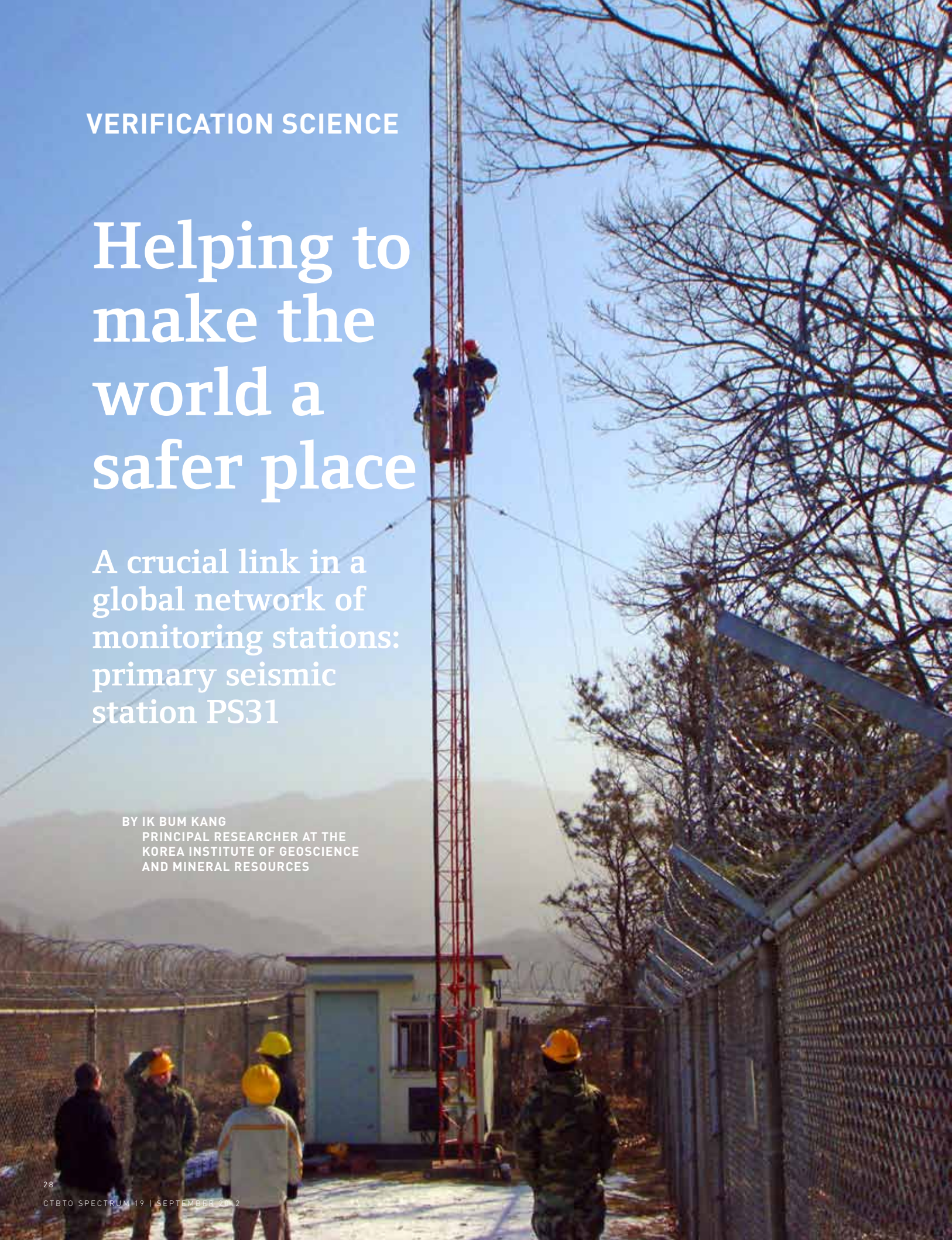
TATSUJIRO SUZUKI has been a Vice Chairman of the Japan Atomic Energy Commission since January 2010. Before that, he was an Associate Vice President of the Central Research Institute of Electric Power Industry in Japan and Visiting Professor at the Graduate School of Public Policy, University of Tokyo. From 1988 to 1993, he was an Associate Director of the Massachusetts Institute of Technology's International Program on Enhanced Nuclear Power Safety. Dr Suzuki is also a former member of the Pugwash Council.

The opinions expressed in this paper are the author's and do not necessarily reflect those of the Japan Atomic Energy Commission or the Japanese government.

Helping to make the world a safer place

A crucial link in a global network of monitoring stations: primary seismic station PS31

BY IK BUM KANG
PRINCIPAL RESEARCHER AT THE KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES



Principal station operator of PS31, Dong-Chang Park, standing in the front row, far left. Principal researcher at KIGAM, Ik Bum Kang, fourth from the left, front row. Senior researcher at KIGAM, Tae Sung Kim, eighth from right.

Operating and maintaining a seismic station located just 130 km from the border with North Korea can be a challenging task. Former Project Manager of PS31 Ik Bum Kang describes the key role his station plays in detecting nuclear explosions.

Monday 9 October 2006 is a day that will remain permanently etched in my memory. The day started normally enough but at 10:36 am local time (01:36 GMT), the seismic monitoring station in Wonju, the Republic of Korea, registered a relatively large event measuring 4.2 in magnitude. This aroused my interest as I was responsible for issues related to the verification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The station – known as PS31 – automatically sent the data that it had recorded in real-time to the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna, Austria, for analysis. At this stage it was still unclear just how important the data would prove to be.

Maintaining primary seismic station PS31, Wonju, Republic of Korea

Just 130 km north of Wonju lies the border with the Democratic People's Republic of Korea (DPRK), more commonly known as North Korea. Six days earlier, on 3 October, North Korea had announced that it was planning to detonate a nuclear device. On 9 October, the country's official news agency issued a press statement declaring that it had conducted a successful underground test.

KEY ROLE IN DETECTING NORTH KOREA'S 2006 NUCLEAR TEST

At the time, PS31 was still operating in test mode, meaning that it was transmitting the seismic data it recorded to the CTBTO's headquarters on a test basis to check the data's availability and reliability. Three weeks later, the station was officially certified by the CTBTO as meeting all of its technical requirements. But even before certification, the data proved to be very precise and reliable and fulfilled the specifications laid out in the operational manual. As part of a network of stations – the International Monitoring System (IMS) – which is being established around the globe to detect all nuclear explosions, PS31 was the closest of 22 IMS seismic stations that registered signals originating from an event in North Korea.

Although the seismic signals were characteristic of a man-made explosion, it was only two weeks later that evidence proving the nuclear nature of the event became available. When an IMS radionuclide station in northern Canada detected traces of the radioactive noble gas xenon 133 in the air, scientists at the CTBTO used backtracking calculations to identify the source of the particles, which could be traced back to North Korea.

Station operators carrying out field work at PS31.

When temparatures plummet, reaching PS31 can prove challenging.

MONITORING NUCLEAR EXPLOSIONS ON THE KOREAN PENINSULA AND BEYOND

PS31 continues to play a key role in monitoring nuclear tests in and near the Korean Peninsula. When North Korea announced that it had conducted a second nuclear test on 25 May 2009, PS31 was one of 61 IMS seismic stations that registered an event measuring 4.5 in magnitude. Over the three years since the first test, the IMS had expanded considerably. By mid-2012, over 80 percent of its facilities were fully operational.

In the Korean Peninsula, local seismic and infrasound stations complement IMS stations to provide more information about man-made events in order to maintain the nuclear-free zone policy in the Korean Peninsula.

RELOCATING FROM CHUNCHON TO WONJU

The original station was established in 1966 near the city of Chunchon, about 64 km north of the current location in Wonju. Situated in Gangwon province on the east side of the Republic of Korea, Wonju has a population of almost 300,000. The Republic of Korea is the only country that shares a land border with North Korea. The country is mostly surrounded by water and has almost 2,500 km of coastline along its three seas.

Despite its proximity to the 'Ring of Fire' and the Circum-Pacific Earthquake Belt, seismicity in Korea is relatively stable compared to its neighbours, China and Japan. Most of the events analyzed every year are less than 2.0 in magnitude and few events are felt by the people living in and near the Korean Peninsula.

PS31 generates the data that helps to distinguish between small-magnitude man-made explosions and natural events that can cause seismic waves such as earthquakes and also plays an important role in investigating seismicity in the region. With regard to natural events, the largest local event the station recorded was the Youngwol Earthquake near Wonju area in 1996, which measured 5.5 in magnitude; and the most significant teleseismic event was the magnitude 9.0 Tohoku Earthquake that struck the north-eastern coast of Japan on 11 March 2011. With regard to nuclear tests, in 1985 the station detected a nuclear test carried out in China and in 1998 it picked up signals from the nuclear tests in Pakistan even though the epicentral distance was more than 10,000 km away.

OPERATING AND MAINTAINING THE STATION

PS31 was installed in 1972 by the Air Force Technical Application's Centre (AFTAC). The location was selected because of its proximity to nearby nuclear countries, namely China, the Soviet Union, and North Korea. At the beginning, AFTAC dispatched about 45 staff to look after the station including technicians and analysts. Now there are seven AFTAC staff and five staff from the Korea

All KIGAM technicians are able to drive the amphibious vehicle required to reach one of PS31's arrays.

The amphibious vehicle called an ARGO 8x8 ATV proves to be indispensable.

Institute of Geoscience and Mineral Resources (KIGAM) who work here as technicians.

KIGAM was established almost 100 years ago and was designated as the National Data Centre (NDC), which is equivalent to serving as the operator of PS31, in 1996. It also conducts comprehensive geological surveys as well as exploring for and developing energy and mineral resources domestically and abroad. As the principal station operator, Dong-Chang Park has full responsibility for everything related to the operation and maintenance of PS31, including the management of team members and the safety of all personnel. KIGAM staff are fully engaged in monitoring nuclear tests by ensuring the safety of the sites and the reliability and availability of the data generated by the 26 elements making up PS31. NDC staff monitor seismic activity in and near the Korean Peninsula around the clock, incorporating data which they receive from the CTBTO's International Data Centre into their analysis.

The NDC also monitors information pertaining to PS31's state of health – in case NDC staff observe any problems at the station which might affect data availability and/or data quality, a duty officer is informed.

Clearing the build-up of snow from a solar panel at PS31.

Station operators carrying out field work at PS31

KIGAM and AFTAC staff relaxing after a hard day's work.

MEETING THE CHALLENGE

The most challenging aspect is that, over the years, the amount of seismic background noise in the Wonju area has risen to make the signal to noise ratio lower, especially in the immediate vicinity of PS31, because of the increase in the volume of traffic and road construction.

Another issue we have to contend with is the station's mountainous location, which entails a trek up to 670 metres above sea level to reach the relay site.

The elements making up PS31 are actually spread over a 30 x 40 km area consisting of rugged mountains and small plains in the valleys. The intra-site communications subsystem is distributed throughout the Wonju array with equipment at every borehole site, which makes servicing the station difficult, especially in rainy or cold weather.

One of the PS31's array elements is especially challenging to reach because there is no road access. It can only be reached by using an amphibious vehicle, called an ARGO 8x8 ATV, to cross the river. All KIGAM technicians have received training in the use of this vehicle.

CAPACITY BUILDING: ONE OF MANY MEMBERSHIP BENEFITS

In order for KIGAM staff to ensure that PS31 is fully operational and continuously maintained, technical support from the CTBTO is essential. A broad range of capacity building activities organized by the CTBTO such as introductory and advanced training courses and workshops for operating and maintaining the station have proven very beneficial.

In October 2008 Korea hosted a Regional Training Programme for Station Operators and National Data Centre Technical Staff at KIGAM's headquarters in Daejeon.

Korea is committed to international peace and security and to further promoting the CTBT and verification-related matters by providing technical assistance to developing countries. This assistance includes capacity building activities related to the operation and maintenance of IMS stations as well as hosting more workshops and training courses.

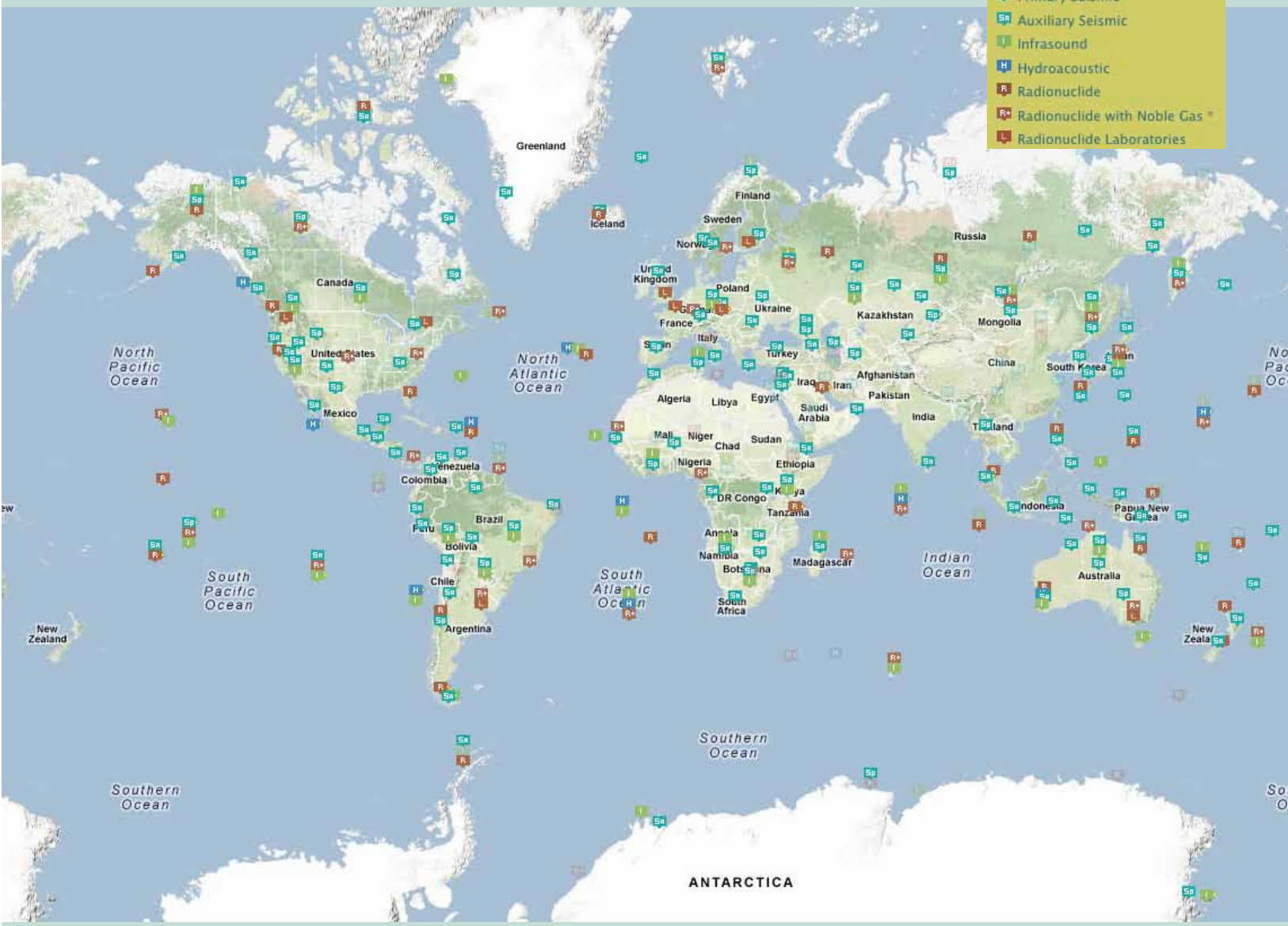
BIOGRAPHICAL NOTE

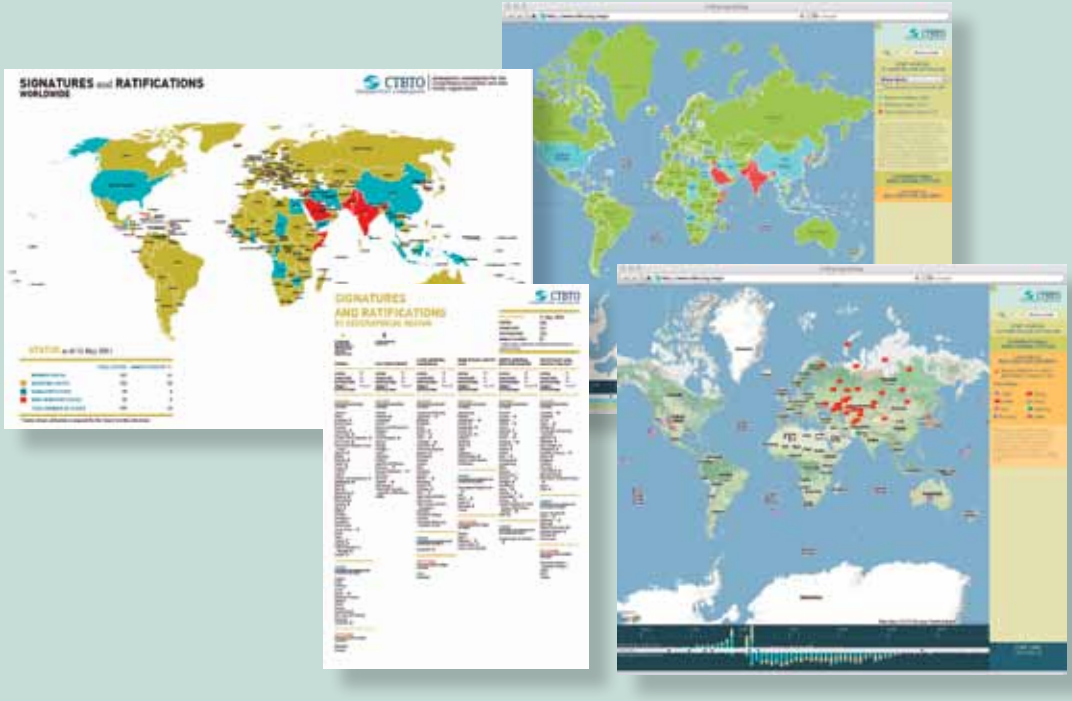
IK BUM KANG
is a Principal Researcher at the Korean Earthquake Research Center of the the Korea Institute of Geoscience and Mineral Resources (KIGAM). Dr Kang has been involved in PS31-related matters since 1996, when the Republic of Korea nominated KIGAM as the Korean National Data Centre responsible for the operation and management of PS31. He has also participated in CTBT-related meetings as the representative of the Republic of Korea since 1996.

STATUS OF CERTIFIED IMS FACILITIES
AS OF 3 SEPTEMBER 2012

CERTIFIED	TESTING	UNDER CONSTRUCTION	PLANNED	TOTAL
272	19	13	33	337

- Primary Seismic
- Auxiliary Seismic
- Infrasound
- Hydroacoustic
- Radionuclide
- Radionuclide with Noble Gas *
- Radionuclide Laboratories





MORE GOOGLE MAP FEATURES

Various new interactive features have recently been added to all the world maps on our website, including:

PDF MAP CREATOR
which allows you to create a printable colour version of the signature/ratification maps on a global and regional basis.

PDF REPORTS
which provides a comprehensive breakdown of the map that was selected

VISIT ONLINE:
www.ctbto.org/map

Practice makes perfect

BY KIRSTEN HAUPT

Getting ready for the next full inspection simulation

Conducting an on-site inspection (OSI) involves a huge amount of technical and logistical preparations. Former CTBTO staff member Kirsten Haupt describes some of the exercises leading up the next full-scale simulated OSI in Jordan in 2014, including the launch phase and testing the logistical aspects of running a base camp.

In September 2008, the CTBTO conducted an ambitious project in Kazakhstan– simulating a complete ground search for tell-tale signs of a nuclear explosion – an on-site inspection. Four years later and building on the lessons learned from the time spent in the Kazakh steppe, the CTBTO is now gearing up for the next big simulation exercise in Jordan in 2014, IFE14.

UNDERSTANDING THE IMPORTANCE OF SIMULATIONS AND ROLE PLAY

Experience shows that simulations and role play are efficient tools for testing the procedures and techniques of an on-site inspection. Playing out their roles helps everybody involved – future inspectors, planners, administrative experts and logisticians – to have a better understanding of their function in the overall operation.

HOW IT ALL STARTS – THE LAUNCH PHASE

The CTBTO currently runs through all aspects of an inspection separately, simulating processes and activities while adhering to one overall game scenario. This way each phase or situation can be played out in detail to identify what works and what doesn't.

In April 2012 it was time to test the launch phase of an inspection. It covers all activities from the receipt of a request for an on-site inspection until the arrival of the inspection team in the State that is suspected of having detonated a nuclear weapon. This phase had never been fully played out before.

Apart from the CTBTO's on-site inspection experts, no one has ever heard of the fictitious States of Equilibria and Forestia. Game planners invented these States for the simulation scenario. At the start of the exercise in April, Equilibria claimed that it had sufficient evidence to show that Forestia had conducted an underground nuclear explosion. Equilibria's request for an on-site inspection kicked off a chain of activities. And the clock started ticking. "The key

ON-SITE INSPECTIONS

FACTS AND FIGURES:
Size of inspection area: 1,000 km²
Number of inspectors:
40 at any given time
Equipment: over 100 tons
Length of inspection:
60 days with possibility of extending to a maximum of 130 days

Once the Comprehensive Nuclear-Test-Ban Treaty (CTBT) has entered into force, a State Party will be able to request an on-site inspection if it suspects that another State has conducted a nuclear explosion.

The State Party subjected to such an inspection cannot refuse to allow it to take place. One of the main benefits of an on-site inspection regime is that it deters potential violators from conducting nuclear explosions in the first place. It thus increases confidence in States' compliance with the Treaty.

The CTBTO tested an almost complete set of on-site inspection techniques and procedures during a month-long exercise in Kazakhstan in September 2008. Photos courtesy of Kirsten Haupt.

thing is that we only have six days to get the inspection team on the ground," said exercise manager Gordon Macleod.

PLANNING FIRST FIELD ACTIVITIES

At the centre of an inspection is a team of inspectors including experts in seismology, geophysics, radionuclides, radiation protection, communications, logistics and IT. In the early phase, a core group of inspectors draft the initial inspection plan in preparation for the all-out ground search. Matjaž Prah, Coordinator of the On-Site Inspection Division at the CTBTO, headed this core inspection team during the launch phase exercise: "In the initial inspection plan we list all activities that we need to conduct in the first two to three days of the inspection."

What are those activities? They include essential issues such as building the base of operations, establishing communication links with the CTBTO's headquarters in Vienna, ensuring communication in the field, organizing accommodation, and – most importantly – initiating inspection activities.

In a real-life scenario, inspectors would be confronted with an area of up to 1,000 square kilometres. The inspection team uses a search logic methodology to narrow down the target areas for their investigation. "One of the first activities most likely to be conducted is the initial overflight," said Prah. "It will give the team an overview of the entire inspection area and generates a huge amount of valuable information for the remainder of the search."

BRINGING IN INSPECTORS FROM ALL CORNERS OF THE GLOBE

Another challenging task is to assemble the team of inspectors. The CTBTO keeps a roster with potential inspectors from all corners of the globe. In the simulation, roughly 120 of them were contacted by email. Although there was no forewarning, an impressive one third of all people contacted indicated their availability.

During the launch phase exercise, the CTBTO's Kim Gensen worked on travel and accommodation arrangements. She explained that this was sometimes tricky as inspectors needed to arrive within a few days of being contacted and from all over the world. There were not just flight schedules and availabilities to deal with, but also visa arrangements for all potential inspectors.

All flight and visa arrangements were genuine. A travel agent was involved. And so was the Austrian Ministry of Foreign Affairs, which helped with the travel procedures. Two cases were particularly authentic from a logistical point of view. Claudia Arango Galvan travelled from Mexico City and Gong Bing from Xi'an in China to join the inspection team. Both geophysicists had been pulled out of their daily routines at extremely short notice and flown to Austria.

LOGISTICAL CHALLENGES

An on-site inspection under the Treaty is a big logistical endeavour. An estimated 100 tons of equipment – from seismic sensors and magnetometers to geophysical instruments and radiation monitoring devices including noble gas detection systems – must be ready on the ground from day one.

In June 2012, the CTBTO tested the logistical aspects of running a base

Kim Gensen (right) made all travel arrangements and had to contend with time restrictions during the launch phase exercise.

Matjaž Prah headed the core inspection team during the launch phase exercise

Participants wore different coloured arm bands to illustrate their role in the exercise during the launch phase.

This facility in Guntramsdorf, Austria, is the starting point for the shipment of tons of equipment to any future inspection exercise.

Top: Future inspectors need to be able to run the pumps for the shower.

Bottom: Building up the camp will test team-building skills.

camp. Inspectors are all specialists in their particular areas. But in the field during an inspection they need to perform tasks that are unrelated to their specialization. For example, they may need to construct their own camp including all tents for working and accommodation as well as sanitary installations. And they may need to be able to run essential equipment such as generators, water supply systems and heaters. Not everyone has done that before so the CTBTO invited potential future inspectors to have test runs with all this equipment.

PRACTICING RADIATION PROTECTION

Radiation protection is a key issue for all future inspectors. Should they get called up to help search for evidence of a nuclear explosion, they will work in potentially contaminated areas. And in addition to their area of expertise, they all need to be familiar with the relevant precautions.

More than 70 experts, who are potential candidates for participation in IFE14, from over 40 countries, underwent a week-long training course on health and safety issues in May 2012 where the focus was on radiation protection. Seasoned radiation health experts instructed participants on the basic principle of ALARA – to keep exposure to radiation As Low As Reasonably Achievable in terms of the time of exposure, distance to the radiation source and by using objects as shields from the source of radiation. Bob Irwin, a Canadian radiation protection expert, was one of the instructors: "Inspectors need to have the tools, the instruments and the training to know what to do when they encounter potentially dangerous situations."

Future inspectors need to know how to erect a tent. This aspect was tested during the base camp exercise in June 2012.

As part of the training, potential future inspectors simulated situations they could face in the field such as suddenly being confronted with elevated radiation. They learned how to identify and mark the source of radiation in a field environment and, very importantly, how to cope with accidental radioactive contamination.

Potential future inspectors were also trained in decontamination procedures at the re-entry to the base of operations after a working day out in the field. It is absolutely essential for the success of an on-site inspection that the base of operations is protected from any accidental

Future inspectors practiced searching for a radioactive source in the terrain in the health and safety training in May 2012. They needed to do so whilst applying safety guidelines.

contamination. Since radioactivity is both invisible and odourless, utmost vigilance is required. As Dharani Wijesundara, a geologist from Sri Lanka and participant in the training, said: "All of us will need to do this someday. It's better to have the training now and I think we need a lot more practice. In future we have to do this on a routine basis." After the Treaty's entry into force, it will be mandatory for all inspectors to undergo radiation protection training as a prerequisite for their participation in an on-site inspection.

TWO MORE YEARS OF PREPARATION

In two years, the next complete run through of an on-site inspection will be played out in Jordan. Until then, there is still a lot that needs to be done to prepare future inspectors. When the CTBT enters into force, this ultimate instrument for verifying Treaty compliance needs to be fully operational. It will be an essential element in the global regime that detects all nuclear explosions.

A central theme of the radiation protection training was to practice using the protective suits.

BIOGRAPHICAL NOTE

KIRSTEN HAUPT
is an historian who worked for CTBTO Public Information from 2005 to 2012. Prior to this, she worked for 13 years in the field of public information in peacekeeping missions in Cambodia and in the former Yugoslavia. She is currently Head of the Editorial and Media Relations Unit at the European Food Safety Authority (EFSA), Parma, Italy.

BY ANGELA LEUKER

A grim, unwanted legacy

The nuclear inheritors can help forge historical change. Yet many young people today are unaware of the existence of global nuclear arsenals.

In a recent series of interviews with the CTBTO, a number of experts on nuclear disarmament and non-proliferation discussed how young people today are shocked when they learn that nuclear weapons still exist in the world – and how they feel cheated that earlier generations have let this situation continue. International security specialist Patricia Lewis calls them the nuclear inheritors.

I guess that makes me something of a nuclear ancestor, even if an unwilling one. Growing up in the UK in the 1960s, I wore the iconic Ban the Bomb logo on my clothes and draped it across my bedroom walls; I knew all of the lyrics to Dylan's 'A Hard Rain's Gonna Fall'; and I joined the Campaign for Nuclear Disarmament's Aldermaston to London marches. I worried about the probability of nuclear war. But then, like most people, I somehow got used to living in the shadow of the mushroom cloud and moved on with my life.

Still, as a nuclear ancestor, I'm constantly surprised by the fact that so many people today are unaware of the continuing threat of nuclear weapons. It's as though in the euphoria following the end of the Cold War, the peace fairy waved her magic wand and nuclear arsenals disappeared forever. Well, sorry to disappoint you, folks, but there are still some 20,000 nuclear weapons in the world today, with nearly 2,000 of them chillingly described as 'on hair-trigger alert'. Just think about those numbers for a minute and digest their meaning. They portend a holocaust of unimaginable proportions.

Of course there are occasional spikes in the public's attention, like those triggered recently in connection with the precise nature of Iran's nuclear programme or whether North Korea will conduct a third nuclear test. But these days it's the issues of political repression, climate change, or the profligacy of the financial world that move people, especially the young, to raise their voices and protest. Images of an impending nuclear war do not keep mankind awake at night.

It's said this is because the fear factor has been neutralized. It faded with the dramatic improvement in relations between the United States and the Soviet Union, the world's two major nuclear powers, in the late 1980s, and disappeared almost completely with the subsequent collapse of the Warsaw Pact and reunification of Europe. Instead of the nightmare of a deliberate nuclear attack provoking a cataclysmic global war, people on both sides of the former divide woke up to a more hopeful future.

How things have changed! Back in the 1950s and 60s, the nuclear threat was almost impossible to avoid. For a start, nuclear testing was commonplace; even announced in the media with a certain sense of national pride. At the same time, the air was thick with accusations fired backwards and forwards between Cold War foes. The face-off created the feeling of living on a nuclear precipice, especially for a public who, back then, generally believed what they were told.

Over the years, as the worldwide peace movement grew and developed its muscle, protest actions against nuclear weapons produced some stunning results, such as the CTBT. Yet here we are, decades later, and even if the gut-wrenching fear has gone, the threat of a nuclear conflict caused by accident or design is patently real.

Now, more than ever, it's time to build a groundswell of opinion to bring about real and lasting change. These days, thanks to modern communications techniques, there is the potential to galvanize people into action on an unprecedented scale. But for that to happen, we all have to work together and share the responsibility, young and old alike. And that means that the nuclear inheritors must be made unequivocally aware of the true nature of their grim legacy.

BIOGRAPHICAL NOTE

ANGELA LEUKER
is a writer and multi-media producer. She worked for more than 20 years as journalist/bureau manager in Time Magazine's Central Europe Bureau before joining the Media and Outreach Section of the International Atomic Energy Agency in 2006. She has been a member of CTBTO's Public Information team since March 2011.

CTBTO
PREPARATORY COMMISSION

COMPREHENSIVE NUCLEAR-TEST-BAN TREATY: SCIENCE AND TECHNOLOGY 2013 CONFERENCE

THEMES:

1. The Earth as a Complex System
2. Events and their Characterization
3. Advances in Sensors, Networks & Processing

17–21 JUNE

HOFBURG PALACE

VIENNA, AUSTRIA

CALL FOR PAPERS
Closing Date: 1 February 2013

CTBTO.ORG/ST2013
#SnT2013

EDITOR-IN-CHIEF:
Annika Thunborg,
Spokesperson and Chief of Public Information

PREPARED, COORDINATED AND EDITED BY:
Denise Brettschneider

CTBTO CONTRIBUTORS:
Kadircan Aktas, Matthias Auer, Mina Faraj,
Krzysztof Kolasinski, Angela Leuker,
Awoba Macheiner, Michèle Marti, Kiel Mathews,
Thomas Muetzelburg, Svetlana Nikolova, Mark Prior

LAYOUT AND DESIGN:
Todd Vincent

DISTRIBUTION:
Pablo Mehlhorn

Photographs and illustrations are at the courtesy of the authors and the Provisional Technical Secretariat.

PLEASE VISIT WWW.CTBTO.ORG
YOUR RESOURCE
FOR STOPPING NUCLEAR TESTING

PUBLISHED BY:
Public Information
Preparatory Commission for the
Comprehensive Nuclear-Test-Ban
Treaty Organization (CTBTO)

Vienna International Centre
P.O. Box 1200
1400 Vienna, Austria
T +43 1 26030 6200
F +43 1 26030 5823
E info@ctbto.org
I www.ctbto.org

CTBTO Spectrum – ISSN: 1680-533X

Printed in Austria, September 2012
on Munken Lynx Paper
wood and acid-free,
certified by the Forest Stewardship Council

Reykjavik

a play by Richard Rhodes

CTBTO
PREPARATORY COMMISSION

Reykjavik re-enacts the Reykjavik summit in October 1986 when U.S. President Ronald Reagan and Soviet General Secretary Mikhail Gorbachev came close to abolishing all nuclear weapons. More than 25 years later, the drama of the meeting and its potential to fundamentally change the course of history continues to ignite the imagination and inspire hopes for the future.

A staged reading of *Reykjavik* will take place in New York in September 2012, followed by a panel discussion: *25 years since Reykjavik – will we get it right in the next 25?* Panellists will consider lessons learned, opportunities missed and what is needed today to move forward in eliminating nuclear weapons.

Panel discussion:

A video message by former President
Mikhail Gorbachev

Panellists:
Morton Halperin
Former presidential advisor

Max Kampelman
Reagan's chief negotiator

Roald Sagdeev
Gorbachev's science advisor

Philip Taubman (moderator)
Former New York Times journalist

Richard Rhodes
Pulitzer Prize-winning author

This event has been made possible by the generous financial contributions of the Government of Japan, which is sponsoring the panel discussion, the Governments of Australia, Kazakhstan, Mexico and Sweden, and the Ploughshares Fund, as well as the assistance of UNODA and UNDPI.

Höfði House in Reykjavik, Iceland was the venue for the 1986 summit between President Reagan and General Secretary Gorbachev.

More information is available at ctbto.org/reykjavik *Twitter: #ReykjavikPlay*