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

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ABDULLAH ENSOUR
PRIME MINISTER OF JORDAN

GROUP OF EMINENT PERSONS
STATEMENT ISSUED ON 11 APRIL 2014

RYAN WILCOX
NORTHERN UTAH DIRECTOR
UNITED STATES SENATE

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

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

As of August 2014, 183 countries had signed the Treaty and 162 had ratified it. Of the 44 nuclear capable States which must ratify the CTBT for it to enter into force (the Annex 2 countries), 36 have done so to date while eight have yet to ratify: China, the Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan and the United States.

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

The regime must be operational when the Treaty enters into force. It will consist of 337 monitoring facilities supported by an International Data Centre and on-site inspection measures. As of 15 August 2014 almost 90 percent of the facilities at the International Monitoring System (IMS) were operational.

COVER IMAGE:
Doomtown XV: Truckee Blast, Bikini Atoll by Doug Waterfield. This painting is part of the artist's 'Doomtown' series. For more information, please see pages 34-35.

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EDITORIAL
LASSINA ZERBO
CTBTO EXECUTIVE SECRETARY

It is my pleasure to introduce this issue of CTBTO Spectrum. This publication comes at the eve of a seminal event for the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The Integrated Field Exercise IFE14 in Jordan in late 2014 will be the organization's largest, most realistic and challenging on-site inspection simulation ever conducted.

In this context, it is a great honour to introduce the article by the Prime Minister of Jordan, H.E. Abdullah Ensour, explaining why hosting the Integrated Field Exercise 2014 is important for peace and stability in the Middle East. Prime Minister Ensour assured me of his country's full support for the exercise when I met him in December 2013. His decision to contribute personally to the CTBTO's magazine is symbolic of Jordan's unique dedication and hospitality as the host country. I would like to express my deep appreciation to Prime Minister Ensour and to all the Jordanian authorities contributing to IFE14.

The fact that one of the largest events in cooperative nuclear arms control and verification over recent years is taking place in the Middle East is highly encouraging and relevant. I am confident that Prime Minister Ensour is correct in his assessment that IFE14, in which experts from most countries in the region will participate, will have a positive impact on regional stability and cooperation.

IFE14 will boost the CTBTO's operational capabilities to conduct an on-site inspection (OSI) under realistic and challenging conditions. In this issue, Gordon MacLeod and Matjaz Prah, members of the project team led by Oleg Rozhkov, Director of the OSI Division, explain which elements and techniques for IFE14 are new compared to those employed in the last full-scale on-site inspection simulation, IFE08, which took place in Semipalatinsk, Kazakhstan,in 2008.

The exercise in Jordan will also help to raise the profile of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) in the region, which is essential for promoting the Treaty's entry into force. Three of the eight countries whose ratification is still required (known as Annex 2 States) are from this region – Egypt, Iran and Israel.

Yet even short of leading to further signatures and ratifications, engaging on technical issues can already create momentum. The recent decision by China, another Annex 2 State, to send data from CTBTO monitoring stations on its territory can be seen in this light. Not only do the data from these stations significantly enhance our system's regional and global coverage, their transmission also clearly demonstrates China's dedication to the CTBT.

Encouraging signs abound. At the April meeting of the Group of Eminent Persons in Stockholm, Sweden, which was hosted by Swedish Foreign Minister Carl Bildt, the Group's impressive energy, creativeness and structured approach were clearly visible. The Group's joint statement adopted at the meeting is featured in this issue.

It is also encouraging to see increasing support from the United States, another important Annex 2 State. With the addition of former Secretary of Defense Willam Perry, the Group of Eminent Persons now has a personality of international standing from the United States.

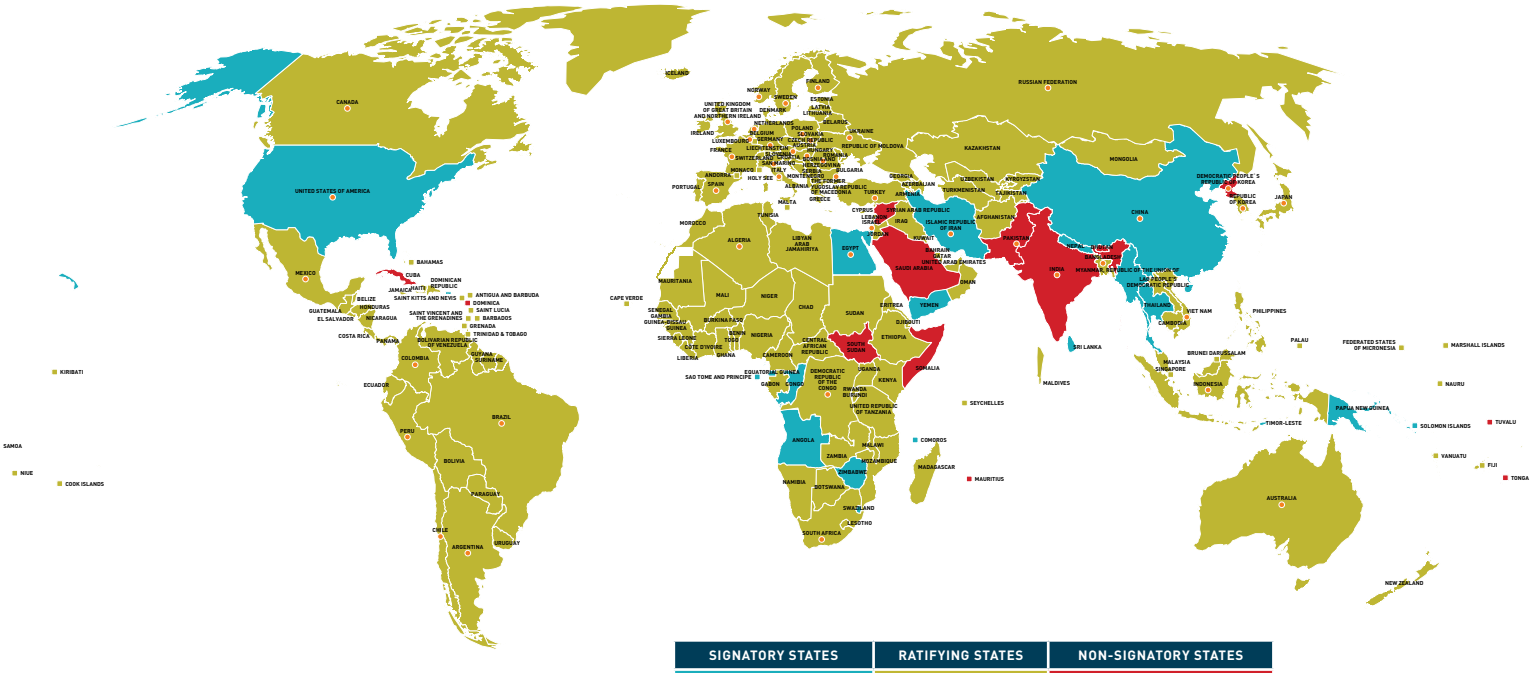
I am particularly heartened to see a representative of the U.S. Republican Party, Ryan Wilcox, Northern Utah Director with the U.S. Senate, make a strong pitch for the CTBT in his article on the test-ban from the state of Utah's perspective. Also in this issue, U.S. author and journalist William Lambers provides an analysis on the prospects of ratification of the Treaty by the United States, while Pakistani journalist Rizwan Asghar does the same for his country.

The only country to isolate itself from the near-global consensus against nuclear testing seems to be North Korea, which has threatened to conduct a "new kind of nuclear test". I sincerely hope that the international community will not need this wake-up call, and we shall make headway on the CTBT's entry into force without additional nuclear tests.

Steady headway is evident on the verification regime which underpins the CTBT. The CTBTO's most complex station rebuilding effort ever has concluded successfully: hydroacoustic station HA03, located on Robinson Crusoe Island, Juan Fernandez Archipelago, Chile, is fully operational again after it was destroyed by a tsunami in 2010. In their article, CTBTO staff members Georgios Haralabus, Lucie Pautet, Jerry Stanley and Mario Zampolli describe the technical and logistical challenges they encountered to ensure that this remote station is back online.

In this issue, CTBTO scientist Mark Prior explains how hydroacoustic technology can help scientists to understand different "soundscapes" in the underwater world, which also includes breaking ice, earthquakes and volcanoes.

STATUS OF SIGNATURES AND RATIFICATIONS
AS OF 15 AUGUST 2014



	SIGNATORY STATES	RATIFYING STATES	NON-SIGNATORY STATES
TOTAL STATES: 196	183	162	13
● ANNEX 2 STATES: 44	41	36	3

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

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Group of Eminent Persons (GEM)

A declaration by the GEM issued on 11 April 2014 at the end of its second meeting in Stockholm, Sweden

1. At the invitation of Carl Bildt, Minister of Foreign Affairs, the Group of Eminent Persons (GEM) met in Stockholm on 10–11 April 2014. The GEM wishes to thank its hosts for the generous support provided for the meeting.

2. The following members of the Group[1] were in attendance: Nobuyasu Abe, Vice Chairman, Japan Atomic Energy Commission; Hans Blix, former Director General of the International Atomic Energy Agency; Des Browne, Chair of the Executive Board, European Leadership Network, Vice-Chair, Nuclear Threat Initiative, and former UK Secretary of State for Defence; Sérgio de Queiroz Duarte, former UN High Representative for Disarmament Affairs; Cristian Diaconescu, Chief of Staff and Adviser to the President of Romania; Wolfgang Hoffmann, Executive Secretary Emeritus of the Preparatory Commission for the CTBTO; John Hutton, Chairman of the Royal United Services Institute for Defence and Security Studies and former UK Secretary of State for Defence; Johannes Kyrle, former Secretary General of the Ministry of Foreign Affairs of Austria; Ho-jin Lee, Principal Vice-President of the United Nations Association of the Republic of Korea; Federica Mogherini, Minister for Foreign Affairs of Italy; Marc Perrin de Brichambaut, former Secretary General of the OSCE; William Perry, Director of the Preventive Defense Project, Center for International Security and Cooperation, and former United States Secretary of Defense; Kevin Rudd, Senior Fellow, Harvard University, and former Prime Minister of Australia; Lassina Zerbo, Executive Secretary of the Preparatory Commission for the CTBTO. Hungary and Indonesia were also represented at the workshop as ex-officio members of the GEM. Balazs Gabor Csuday, Permanent Representative of Hungary to the UN in Vienna, and Rachmat Budiman, Permanent Representative of Indonesia to the UN in Vienna, represented János Martonyi, Foreign Minister of Hungary, and Marty Natalegawa, Foreign Minister of Indonesia, who are ex-officio members of the GEM.

3. Through a series of discussions, while acknowledging the primary role of the Article XIV process, the Group reflected on how it could best advise and assist the Executive Secretary on securing the entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Broader strategic approaches and modes of action were considered, in addition to focused discussions on the eight remaining Annex 2 States yet to ratify the Treaty.

4. The GEM discussed thoroughly the need for entry into force of the CTBT in order to complete a global, legally-binding prohibition on nuclear weapon test explosions or other nuclear explosions. The Group also noted that entry into force and universalization of the CTBT would strengthen international disarmament efforts and the nuclear non-proliferation regime. In this regard, the Group stressed that the CTBT should also be approached in terms of its close links with the Treaty on the Non-Proliferation of Nuclear Weapons and with the concept of nuclear security.

5. While confident that entry into force of the CTBT is within reach, the GEM acknowledged the significant challenges that exist in pursuit of this goal. These include galvanizing and maintaining political momentum, and continuing to secure adequate technical and financial support for the CTBT verification regime.

6. The GEM therefore resolved to support entry into force and universalization of the CTBT through multilayered engagement at the national, regional and global levels, including:

- *Direct engagement with policymakers;*
- *Active participation in significant public events at which the CTBT can be raised;*
- *Promotion of the Treaty through media outreach; and*
- *Utilization of networks and force multipliers, including political, civil society, and academic links, to broaden and diversify support for the Treaty.*

7. The GEM accepted the kind invitation of Federica Mogherini, Minister for Foreign Affairs of Italy, and member of the GEM, to meet in Italy.

8. The GEM acknowledged the kind invitation of János Martonyi, Minister of Foreign Affairs of Hungary, ex-officio member of the Group and Co-President of the Process to Facilitate the Entry into force of the CTBT, to hold its next meeting in Hungary in the autumn of 2014.

[1] The other members of the Group who were not present at the meeting in Stockholm are: Perla Carvalho, Special Adviser for Security, Disarmament and Non-Proliferation Issues, Mexican Ministry of Foreign Affairs; Jayantha Dhanapala, President of Pugwash Conferences on Science and World Affairs and Deputy Chairman of the Governing Board of the Stockholm International Peace Research Institute; Igor S. Ivanov, President of the Russian International Affairs Council and Professor at the Moscow State Institute of International Relations; Sha Zukang former United Nations Under-Secretary-General, Department of Economic and Social Affairs; and, Héctor Timerman, Minister of Foreign Affairs of Argentina.

It was the GEM's first meeting since its launch in New York in September 2013.

»We lived through one very dangerous nuclear arms race during the Cold War. We were lucky that that arms race did not result in nuclear catastrophe. We may not be so lucky a second time.«

William Perry
Former U.S. Secretary of Defense

»The inauguration of the GEM last September has reaffirmed my belief that the eminent personalities who have become part of this Group possess the insight and experience to finally break the political stalemate that has engulfed the CTBT in recent years.«

Lassina Zerbo
CTBTO Executive Secretary

»The positive developments of the Iran nuclear negotiations can help the cause of the CTBT.«

Carl Bildt,
Swedish Foreign Minister

Federica Mogherini, Italian Foreign Minister (left) and Carl Bildt, Swedish Foreign Minister, during the meeting of the GEM in Stockholm. Sweden, from 10 to 11 April 2014. The meeting was hosted by the Swedish Ministry of Foreign Affairs.

BACKGROUND
GROUP OF EMINENT PERSONS

On 26 September 2013 a group comprising distinguished personalities and internationally recognized experts was launched at the United Nations Headquarters in New York. This Group of Eminent Persons (GEM) will support and complement efforts to promote the entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) as well as reinvigorating international endeavours to achieve this goal.

The Integrated Field Exercise 2014: Its importance for peace and stability in the Middle East

BY PRIME MINISTER
ABDULLAH ENSOUR OF JORDAN

"Jordan has always spared no effort, since the time of my father, His Majesty the late King Hussein, to avoid nuclear proliferation and a nuclear arms race in the Middle East, which would have unimaginable consequences well beyond our region. Not only have we signed every major international treaty and convention to prevent nuclear proliferation and secure nuclear materials, but we have also long been strong advocates for the establishment of a zone free of nuclear weapons in the Middle East. It is a major challenge, but one that we must meet."

With these words His Majesty King Abdullah II Ibn described Jordan's unwavering commitment to nuclear disarmament and non-proliferation in 2012.

A THREAT OF NIGHTMARISH PROPORTIONS

Why is it so essential that our kingdom rises to this challenge? Jordan finds itself surrounded by a ring of fire: the Syrian tragedy, in which Jordan shelters more refugees than any other country, the simmering Arab-Israeli dispute and escalating tensions in Iraq, all exacerbated by a difficult economic climate and dwindling natural resources.

In this volatile security environment, the proliferation of nuclear weapons would be the straw that broke the camel's back. In particular, the notion of nuclear weapons in the hands of a multitude of hostile, not necessarily rational actors is a threat of nightmarish proportions for regional and global security.

This is why Jordan has chosen to fully embrace all treaties and instruments aimed at nuclear disarmament and non-proliferation, including the Nuclear Non-Proliferation Treaty (NPT), the International Atomic Energy Agency's Additional Protocol and the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

This important step demonstrates to our neighbours, in a clear and verifiable way, that Jordan's nuclear programme is exclusively peaceful in nature. Our need for energy, which can only be fully met by including nuclear energy in the mix, is evident: As the fourth water-poorest country in the world, Jordan depends on energy-intensive desalination plants to sustain its growing population.

ALL PEACE-LOVING NATIONS SHOULD EMBRACE THE CTBT

Of all the relevant international norms, the CTBT in particular should come naturally to peace-loving countries. By banning nuclear test explosions, this Treaty prevents the military use of nuclear technology, blocking the path to the one weapon capable of ending human civilization. Unlike other multilateral instruments, the CTBT has no repercussions whatsoever for the civilian use of nuclear technology.

»Of all the relevant international norms, the CTBT in particular should come naturally to peace-loving countries.«

The CTBT's entry into force would mark a milestone on the way to a world free of nuclear weapons. It would show progress in the disarmament promise made by nuclear weapon States decades ago and thus strengthen the international commitment to the NPT. It would certainly give fresh momentum to the aspiration of a nuclear-weapon-free zone in the Middle East.

A key consideration for any arms control treaty is its verifiability. When North Korea conducted nuclear tests in 2006, 2009 and again in 2013, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) detected the events reliably and precisely, making the data available to Member States in near real-time. The CTBTO seismic station hosted by Jordan at Tel-Alasfar, near the border with Syria, contributed to the analysis of these events.

A MATTER OF NATIONAL SOVEREIGNTY

The capability to receive and analyse CTBTO monitoring data through its CTBT National Data Centre is an expression of national sovereignty, especially against the background of Jordan's membership in the United Nations Security Council in 2014 and 2015. Independent of the most technologically advanced countries, Jordan is now able to arrive at its own assessment of suspicious events, should any country – regrettably – decide to conduct a nuclear test.

In addition to detecting nuclear tests, CTBTO monitoring data have proven valuable for other purposes, such as natural disaster warning, studies of the Earth's inner structures and climate change research. Jordanian experts have participated in CTBTO workshops and training activities to build national expertise in this regard.

PARTICIPANTS FROM DIFFERENT MIDDLE EASTERN COUNTRIES WORKING SIDE BY SIDE

Jordan has chosen to actively support the CTBTO by offering to host the next full-scale on-site inspection exercise, the Integrated Field Exercise 2014.

This will be the second such simulation conducted by the organization since the last exercise in Kazakhstan in 2008. The successful demonstration of the CTBTO's operational capabilities to conduct an on-site inspection under realistic conditions will further strengthen the case for the Treaty's entry into force.

The exercise will also have an important symbolic dimension: with over 200 participants, it will bring together experts from every continent. All Middle Eastern countries have been invited to work side by side for the common cause of strengthening global security.

EAGER TO PROVIDE UTMOST SUPPORT

It fills me with pride that the 182 other CTBTO Member States chose Jordan to host the Integrated Field Exercise 2014 in a competitive process. The Dead Sea area provides the perfect topography and geology for a realistic and challenging on-site inspection simulation, and the

»The CTBT's entry into force would mark a milestone on the way to a world free of nuclear weapons.«

Experts from Jordan were amongst the 100 participants at the National Data Centre workshop in Vienna, 12–16 May 2014.

Dead Sea itself, with its modern resorts, is the perfect location to re-energize after a long day in the field.

Furthermore, our experts in all parts of the Jordanian government are eager to provide their utmost support to the exercise, as I assured CTBTO Executive Secretary Lassina Zerbo during his visit to Amman in December 2013. In the words of His Majesty King Abdullah II Ibn Al-Hussein, "First and foremost are our people: talented, educated, tech-savvy and globally aware."

The agencies involved, many of which have contributed to the variety of CTBTO exercises and workshops that Jordan has hosted since 2003, include the Natural Resources Authority, the Jordan Atomic Energy Commission, the Jordan Nuclear Regulatory Commission, the Ministries of Foreign Affairs, Interior and Health, as well as the Royal Jordanian Air Force.

The Integrated Field Exercise will in turn augment the technical and professional skills of our experts and scientists in the field because they will be able to familiarize themselves with state-of-the-art technology, methods and equipment. This will increase, for example, our country's expertise in detecting airborne radioactivity and radioactive noble gases. The discussion on the participation of Jordan's scientific and academic community in the exercise made a promising start with a roundtable discussion hosted by the Middle East Scientific Institute for Security in late 2013.

I wish Executive Secretary Zerbo and his team a successful and instructive Integrated Field Exercise 2014. This event will mark the beginning of a safer and brighter future for the Middle East and the world.

In anticipation of this event, I would like to bid all participants a heartfelt welcome to beautiful and hospitable Jordan.

Installation of the borehole seismometer for auxiliary serismic station AS56 at Tel-Alasfar, Jordan
Image courtesy of Walid Mohammad.

The Integrated Field Exercise 2014 will take place in the Dead Sea area, Jordan.

»The Dead Sea area provides the perfect topography and geology for a realistic and challenging on-site inspection simulation, and the Dead Sea itself, with its modern resorts, is the perfect location to re-energize after a long day in the field.«

BIOGRAPHICAL NOTE

ABDULLAH ENSOUR
was appointed as the Prime Minister of Jordan in October 2013. His first ministerial post was as Minister of Planning in 1984. He has held various cabinet positions in Jordanian governments since then, including Minister of Education, Minister of Foreign Affairs, Minister of Industry and Trade, Minister of Higher Education, Minister of Administrative Development and Minister of Information. Dr Ensour has also served as governor of Jordan to the World Bank and deputy of Jordan to the International Monetary Fund.

Michele, Jessilyn, Sheldon & Utah

BY RYAN WILCOX
NORTHERN UTAH DIRECTOR,
UNITED STATES SENATE

Michele Garner, Jessilyn Turner, Sheldon Nisson. All three children were born in southern Utah in the United States in the 1950s. Michele was seven, Jessilyn, nine, and Sheldon, thirteen, when they died of cancer attributed to atmospheric nuclear testing. They were roughly the same age as my children are now.

On 27 January 1951 the Atomic Energy Commission (AEC) detonated a one-kiloton nuclear bomb, dropped from an airplane at Frenchman Flat, the first of nearly 1,000 nuclear explosion tests at U.S. government-controlled property in Nevada. The AEC press release promised that atomic tests would be conducted "with adequate assurances of safety". Patriotic citizens of southern Utah and the surrounding states who lived immediately downwind of the test site initially believed what they were told. As one historian wrote: "Their faith and trust in their government would not allow them to even consider the possibility that the government would ever endanger their health."

PREPARING FOR A POSSIBLE NUCLEAR ATTACK

Declassified AEC transcripts released nearly 30 years later show that scientists knew, and decision makers ignored, as early as 1947 that fission particles released from atomic bomb testing could be deadly to humans and animals alike exposed both during and after the tests. Residents, eager to trust their government and fearful of a nuclear attack from the Soviet Union, built bomb shelters, stored extra food and practiced bomb drills at school, doing their best to be prepared for the possibilities of the nuclear threat.

Scott M. Matheson, father of current Utah Congressman Jim Matheson, served as the Governor of Utah from 1977 to 1985 and moved to southern Utah just after testing began. He recollected: "People in southern Utah were mainly concerned with making a living, and I don't recall anyone being too upset about the brilliant flashes and thunder-like blasts that were part of the 1953 atomic testing. ...People were concerned about the sheep deaths that occurred in May 1953, but when the AEC said there was nothing to worry about, we all just shrugged our shoulders. No one really accepted the malnutrition rationale, but we were used to accepting whatever the government said, especially during that very nationalistic period."

»Tragically, for Utah families in places like St. George – a city in the south west of the state – losing loved ones to fallout became so commonplace that it received the infamous nickname 'Fallout City.'«

The 1970 Baneberry "underground" nuclear test at the Nevada Test Site, USA.

In 1979, nearly 30 years after nuclear testing began at the Nevada Test Site, then Governor Matheson held hearings which included over 1,100 pages of testimony detailing the AEC cover-up and the increasingly apparent consequences faced by Utahans, years before he personally would feel those very effects.

Scott Matheson died from multiple myeloma, a rare form of cancer, on 7 October 1990. This came merely two days after the U.S. Congress passed the Radiation Exposure Compensation Act (RECA) in an attempt to compensate those suffering from cancer and a number of other diseases attributed to the fallout from nuclear testing.

Tragically, for Utah families in places like St. George – a city in the south west of the state – losing loved ones to fallout became so commonplace that it received the infamous nickname "Fallout City."

After her death in 1966, Michele Garner's father reportedly said: "The thought of radiation fallout did cross my mind although the authorities said it was harmless." A 1955 AEC brochure had reassured the public that the radiation from nuclear testing "does not constitute a serious hazard to any living thing outside the test site."

UNDERGROUND NUCLEAR EXPLOSIONS WERE NOT ALWAYS CONTAINED SUCCESSFULLY

Yet the danger persisted even when testing moved underground in 1963. Nuclear test crews did not always succeed in containing the explosions, causing a release of radioactive dust into the atmosphere. The 1970 Baneberry test turned into one of the worst radiological incidents in U.S. history.

Even when an underground test is successfully contained, certain radioactive substances linger for thousands of years in the ground, threatening not only the soil, but ground water as well.

The effects were not limited to Utah. According to the National Cancer Institute's revised estimates in 1999, exposure to radioactive iodine from the Nevada atmospheric tests would produce between 11,300 and 212,000 excess lifetime cases of thyroid cancer[1]. Persons who were children during the period of exposure would be at higher risk.

As the casualties piled up, families throughout Utah banded together, resulting in a series of resolutions being passed in the Utah legislature. These included HCR 1 (2001) and HCR 7 (2005), and culminated in a unanimous bipartisan vote on 2010's HR 004 that I co-sponsored with Representative Jennifer Seelig (Democrat), calling for U.S. Senate ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The plight of the casualties was acknowledged at the federal level in 2011 with the designation of 27 January – the day of the first test at Nevada – as the National Day of Remembrance for Downwinders.

The federal government decided to stop U.S. nuclear testing in 1992. There are no active plans to resume U.S. nuclear testing, yet despite overwhelming

[1] National Academies Press (U.S.) 1999 report. *Exposure of the American People to Iodine-131 from Nevada Nuclear-Bomb Tests: Review of the National Cancer Institute Report and Public Health Implications.*

evidence, the Nevada Test Site is kept on standby to resume testing. The United States is not alone: the door remains open for other countries to resume nuclear testing, threatening to rattle global security – and anyone who happens to live downwind.

THE CTBT: PUTTING AN END TO ALL NUCLEAR EXPLOSIONS

Fortunately, a solution is within reach. An international treaty outlawing all nuclear testing exists, but it has yet to enter into force. The 1996 CTBT bans all nuclear tests in all environments, including underground. The United States was the first to sign the CTBT, but it still needs to ratify along with seven other countries listed in the Treaty as nuclear technology holders.

While U.S. ratification may not prompt all of the remaining States to follow suit immediately, China and Israel are likely to do so, followed by India and Pakistan. Iran would have a much harder time claiming that its nuclear programme is purely peaceful while not ratifying the CTBT. Egypt is likely to come on board when most others have done so. And North Korea, presumably the most stubborn of the holdout States, would face stronger international pressure to stop its nuclear testing and missile programme.

CTBT ratification was rejected in the U.S. Senate in 1999, a decision that many Republicans supported, myself included. One key concern that led to many "no" votes was how and whether the Treaty could help detect and deter cheating by others while the United States faithfully abides by the rules. A justified question, to which there was no satisfactory answer at the time. Yet today there is.

THE WORLD'S MOST SOPHISTICATED MULTILATERAL VERIFICATION SYSTEM

Over the past 15 years, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna, Austria, has established the world's most sophisticated multilateral verification system. Over 300 stations around the globe constantly monitor the ground, the air and the oceans for shockwaves and catch the faintest sniff of radioactivity. The system detected all three North Korean nuclear tests in 2006, 2009 and 2013; the tests all received universal condemnation. The 2012 report by the U.S. National Academy of Science confirms the CTBT's capabilities, especially when combined with the United States' own impressive means of surveillance.

The other concern that was raised in 1999 was whether our arsenal could be maintained in the absence of explosive testing. This has been addressed as well. The nation's Stockpile Stewardship and Management Program, which was still in its infancy back then, has proven to be highly reliable and effective. George Shultz, former U.S. Secretary of State in the Reagan administration at the height of the Cold War, stated in April 2009: "[Republicans] might have been right voting against [the CTBT] some years ago, but they would be right voting for it now, based on these new facts."

In short, ratification ensures that we can both preserve our nuclear deterrent, and prevent further proliferation both at home and by enemies abroad.

THE "ABSURDITY" OF NUCLEAR WEAPONS

A few years ago, I had a conversation with former Air Force pilot, NASA astronaut, and retired U.S. Senator from Utah, Jake Garn. Senator Garn related the story about the moment that he first saw the Earth while in orbit aboard the Space Shuttle Discovery. I will never forget his description of what he saw: that from space, there are no lines; no borders; no artificial divisions among nations. Pausing, he reflected on "the absurdity" of nuclear weapons – and the imaginary concept that the consequences of their use will stop at the border.

1955 federal government brochure on the effects of nuclear testing.

The National Cancer Institute Study found traces of Iodine 131 as a result of nuclear testing in every county in the nation, with hotspots where nuclear clouds had settled throughout the intermountain west and as far away as upstate New York.

The premature deaths of hundreds of thousands of people in the United States and around the world from nuclear fallout cannot be undone. However, we do have the chance to silence nuclear testing forever. We have both the opportunity and responsibility to leave our children a safer world than Michele, Jessilyn and Sheldon ever had.

Ratification is no longer a matter of an unknown, undetectable threat. Today, it is a matter of political courage. It is a matter of will.

BIOGRAPHICAL NOTE

RYAN D. WILCOX
served in the Utah House of Representatives in the United States from 2009 to 2014. Representative Wilcox was the Chairman of the House Revenue and Taxation Committee. He also served on the House Natural Resources, Agriculture, and Environment Committee, and House Public Utilities & Technology Committees. In national politics he has continuously supported ratification of the CTBT. He currently serves as Northern Utah Director with the United States Senate.

Nuclear Peace

Emerging in the Middle East

BY WILLIAM LAMBERS

It's in every nation's interest to be free of the expensive and dangerous burden of nuclear weapons. When we hear estimates from Global Zero of about $1 trillion being spent in the next decade on nuclear weapons, we should all be in shock. For that is certainly not the road to peace and progress.

We have an alternative. We can reduce the burden of nuclear weapons with a step-by-step approach, one country, one region and one treaty at a time. This peace process includes agreement with Iran over its nuclear programme and all nations ending nuclear testing forever.

Iran clearly cannot afford to be diverting precious resources to the pursuit of nuclear weapons. All eyes right now are on negotiations to prevent Iran from developing nuclear weapons.

Iran has suffered from sanctions for failing to live up to obligations under the Nuclear Non-Proliferation Treaty. A report from the International Federation of Human Rights published in June 2013 stated the consequences for the Iranian people:

»President Obama is committed to ratifying the CTBT, finishing a goal shared by almost every president since Dwight Eisenhower.«

"Unemployment is on the rise, inflation is at unprecedented levels and most people have to combine several jobs because the minimum wage is insufficient to counterbalance inflation. Iran's population is experiencing an increasing income gap between rich and poor."

As President Obama said in his statement on 23 November 2013 on the first step agreement on Iran's nuclear programme: "Iran must know that security and prosperity will never come through the pursuit of nuclear weapons – it must be reached through fully verifiable agreements that make Iran's pursuit of nuclear weapons impossible."

This year brings great hope for a comprehensive agreement with Iran. But why stop there? There are more steps that need to be taken to stop nuclear proliferation.

SHUTTING THE DOOR ON NUCLEAR TESTS FOREVER

Jordan, for example, is hosting a large-scale simulated inspection exercise for the Comprehensive Nuclear–Test-Ban Treaty (CTBT) in late 2014. This Treaty bans all nuclear weapons test explosions.

The 1963 Limited Nuclear Test Ban Treaty already bans tests in the atmosphere, underwater and in outer space. The CTBT would shut the door on nuclear tests by prohibiting underground testing too.

Not all nations though are on board. Eight countries still need to ratify the CTBT for the pact to take effect globally: China, Egypt, India, Iran, Israel, North Korea, Pakistan and the United States. The only nation to conduct nuclear tests recently has been North Korea, which has done so at the expense

of its starving citizens. North Korea is an example that no one wants to follow.

By ratifying the CTBT the United States would demonstrate leadership in the non-proliferation field.

The Treaty is vital for creating the conditions for deeper nuclear arms reductions. In fact, the 1996 Canberra Commission on the Elimination of Nuclear Weapons stated: "…the CTBT obligation permanently to cease or forgo nuclear testing sets the psychological stage for moving toward elimination of nuclear weapons."

If the United States or Russia were to resume nuclear weapons tests they would be followed by others, leading to a costly arms race and increased tensions.

Russia has said it will continue a voluntary nuclear-testing moratorium "as long as other nuclear weapons States do the same."[1] If this moratorium were tragically to end it would be like a return to the Cold War days. No one wants to see that again. The only place left for nuclear tests is the history books.

RESOURCES SHOULD NOT BE WASTED ON NUCLEAR TESTING AND DEVELOPMENT

What we want to see is the opposite. We want nations to join treaties like the CTBT and save their resources for more important objectives than nuclear testing and development. The Center for Arms Control and Non-Proliferation says that "China is very likely to ratify the CTBT after the U.S. does." Certainly, India and Pakistan are much more likely to join if the United States has signed on. Neither country can afford nuclear weapons with their high rates of hunger and poverty.

The CTBT is enforced through an international monitoring and inspection system, the one that will be tested

[1] Remarks by H.E. Alexander V. Zmeyevskiy, Permanent Representative of the Russian Federation to the CTBTO, at the fifth conference to promote the CTBT's entry into force, September 2007.

Jordan's Minister of State for Media Affairs and Communications, Mohammad Al Momani (left) with CTBTO Executive Secretary Lassina Zerbo, in Amman, Jordan, on 2 December 2013, announcing that Jordan will host the CTBTO's Integrated Field Exercise 2014.

in Jordan later this year (for more information, see page 26).

Mohammad Hussien Al Momani, Jordan's Minister of State for Media Affairs and Communications, recently stated: "Jordan is proud to host this exercise. It is in line with Jordan's desire to strengthen the nuclear disarmament and non-proliferation framework, in particular in the Middle East."

Nearly 20 years ago, the government of Canada published a paper on aerial inspection confidence building measures to help build peace in the Middle East. The upcoming CTBT inspection exercise in Jordan could also be a good building block for future security in the Middle East and the world.

President Obama is committed to ratifying the CTBT, finishing a goal shared by almost every president since Dwight Eisenhower. In fact, President Eisenhower and President Kennedy both supported the goal of ending nuclear testing, and their efforts did achieve the Partial Test Ban Treaty (PTBT), which entered into force in 1963. Both Republicans and Democrats supported this plan. The Senate would need to show the same kind of bipartisan cooperation to get the CTBT passed today.

When Kennedy sent the PTBT to the Senate, former members of the Eisenhower administration spoke in favour. Harold Stassen, disarmament advisor under Eisenhower, told the Senate: "I emphasize that this treaty is in the best interests of mankind."

Stassen went on to warn of the dangers of failing to impose restraints on nuclear weaponry, stating that nuclear proliferation "would multiply the dangers of a miscalculated firing of a nuclear bomb, or a madman's first nuclear attack, or an accidental nuclear explosion, or a foolhardy overplayed nuclear bluffing, or other action which would, in a terror-tense world set off a chain reaction of horrible nuclear devastation." Any questions?

Ending nuclear testing was part of what President Kennedy referred to as a "peace race – to advance together step by step, stage by stage, until general and complete disarmament has been achieved."

When Kennedy pushed the PTBT through the Senate he had the support of the public through the Citizens Committee for a Nuclear Test Ban Treaty. This committee was headed by one of Eisenhower's test ban negotiators, James Wadsworth.

Soviet and American scientists at the 1958 Geneva Conference of Experts discussing nuclear test detection.

U.S. President John F. Kennedy ratifying the Partial Test Ban Treaty, 7 October 1963.

NO TOTAL NUCLEAR DISARMAMENT WITHOUT A TEST BAN TREATY

It was Wadsworth who wrote in 1962: "Failure in the nuclear-test-treaty talks would be a very bad omen indeed for success in the broader area of negotiations." He was among many, both Democrats and Republicans, who were committed to ending nuclear testing. There could be no total nuclear disarmament, after all, without a test ban treaty.

The Citizens Committee even included statements of support from college and university presidents from Oregon, Purdue, Florida, Pittsburgh, Harvard and many others. Dr James Killian, Eisenhower's science advisor, was a member of Kennedy's Citizens Committee.

»The only place left for nuclear tests is the history books.«

Today, there are groups like Global Zero, the Ploughshares Fund and the Friends Committee on National Legislation who can help build that public support for the CTBT. These organizations have dedicated followers worldwide who can build significant support for the CTBT, which is so essential for progress on nuclear disarmament.

We can't let up when it comes to non-proliferation. We cannot as a world society forget that nuclear weapons and their dangers still very much exist. The job of nuclear arms control and disarmament is still far from complete.

Support for the CTBT, as well as for successful negotiations with Iran, will be so crucial for today's race for peace.

A lasting agreement with Iran and ratification of the CTBT are two goals within reach. It's diplomacy in action, the only road to peace and nuclear disarmament.

U.S. President Dwight Eisenhower's making a statement on suspending nuclear testing on 22 August 1958.

An earlier version of this article was featured in The Huffington Post on 2 January 2014.

BIOGRAPHICAL NOTES

WILLIAM LAMBERS
is an author and journalist. His writings have been published by *The New York Times, Huffington Post, Cincinnati Enquirer, Providence Journal, Des Moines Register, History News Network* and other media outlets. His books include *Nuclear Weapons* and *The Road to Peace*.

Preparing to detonate the world's first nuclear weapon: the Trinity test was conducted on 16 July 1945 in New Mexico, USA.

The Future of the CTBT

BY RIZWAN ASGHAR

»Once the United States ratifies the Treaty, the remaining holdout States will most likely be stimulated to follow suit due to the fear of being marginalized by choosing to remain outside of the Treaty.«

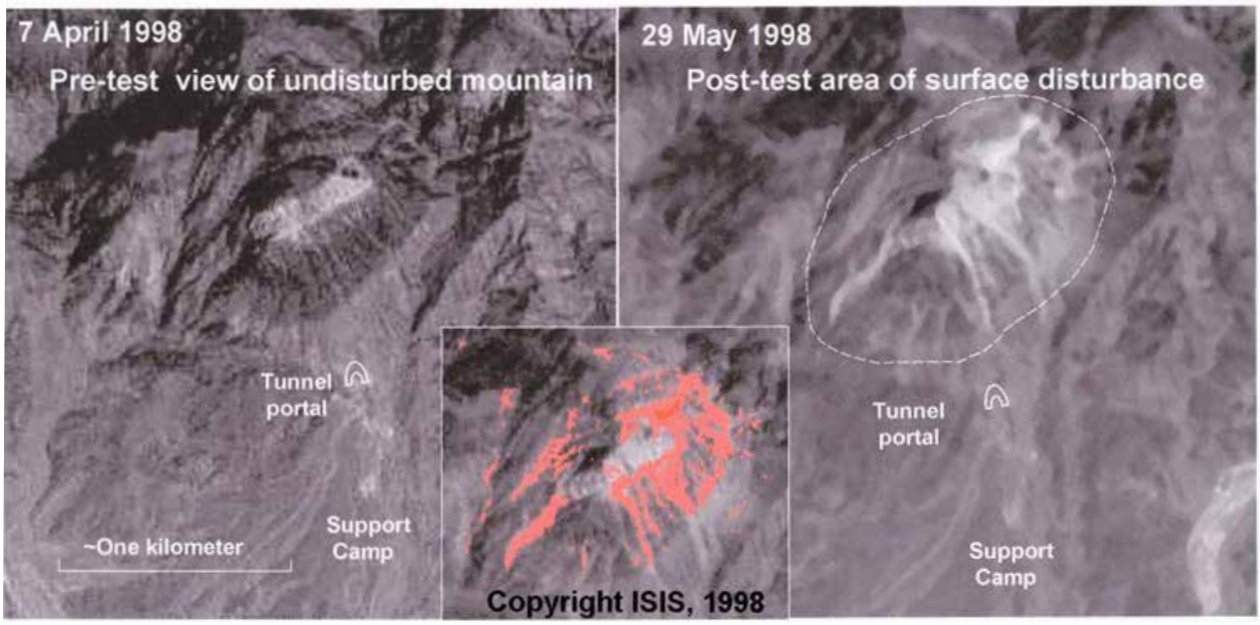
Global efforts to halt the quantitative and qualitative nuclear arms race by preventing nuclear weapons testing started less than a decade after the first nuclear explosive test was carried out in Alamogordo, New Mexico, USA, in 1945. On the larger non-proliferation canvas, a global ban on nuclear explosions has remained one of the longest standing items on the international agenda. Arms control advocates have consistently pushed for the adoption of a treaty banning all nuclear explosions but no binding framework could be put in place. To date, more than 2,000 nuclear tests have been carried out at 60 different locations around the globe.

As the existential threat posed by the existence of nuclear weapons has emerged once again, following the three nuclear tests conducted by North Korea so far this century, a new momentum is gathering for a worldwide ban on nuclear testing. For more than two decades, nuclear experts have considered ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which bans nuclear explosions in all environments, as essential for achieving this goal. However, the Treaty remains stuck in limbo due to the political processes in some countries, which can be complicated and lengthy, and the 'after you' policy adopted by certain countries. It has now been more than 17 years since the CTBT was opened for signature. As of 30 July 2014, more than 180 States had signed the CTBT and 162 had ratified it. A deadlock exists because one of the Treaty's clauses – known as Article XIV – makes ratification by 44 States with commercial or research nuclear reactors a necessary requirement for the Treaty to become legally binding. Of those 44 specified states, China, Egypt, India, Iran, Israel, North Korea, Pakistan and the United States, have so far been reluctant to ratify.

CONSIDERING THE OPTION OF 'PROVISIONAL APPLICATION' OF THE CTBT

Under the present circumstances, the chances of the CTBT's ratification by

Pre- and post-test commerical satellite image comparison of the 28 May 1998 Pakistan nuclear test Site showing physical test effects



IRS-1C 5-m resolution image Courtesy: Space Imaging, Inc.

Detected changes through digital image subtraction shown in red (By Frank Pabian)

IRS-1C 5-m resolution image Courtesy: Space Applications International Corporation

"Satellite Images of Pakistan's 28 May 1998 Test Site," Institute for Science and International Security, 28 May 1998, http://isis-online.org/isis-reports/detail/satellite-images-of-may-28-1998-test-site/12#images.

these unwilling countries are slim. With China linking its ratification process to that of the United States and Pakistan waiting for India to ratify first, achieving the CTBT's entry into force has been a daunting challenge. After the CTBT was defeated by the U.S. Senate in 1999, the Bush administration made little effort to promote it although U.S. ratification could have also spurred Egypt and Israel to sign and ratify the Treaty. President Obama expressed his strong commitment to the CTBT on many occasions during his first term but later it slipped down his agenda due to other domestic political concerns. In order to break this deadlock, many non-nuclear weapon States are considering the option of 'provisional application' of the CTBT until the Article XIV conditions are met in full.

This approach will not only enable the consenting States to avoid unnecessary political obstacles but will also strengthen nuclear test-ban regimes. Without violating the provisions of Article XIV of the Treaty, this approach is likely to increase pressure on other countries to accelerate their ratification processes. After it has been applied provisionally by a large number of States the CTBT will have an enhanced legal status, increasing the political costs of violation. In this way, the Treaty would provide a stronger legal basis for collective United Nations action against the violator and there would be a glimmer of hope to prevent failure of the 'test-ban' norm.

THE CTBT DOES NOT RULE OUT PROVISIONAL APPLICATION

According to Article 25 of the 1969 Vienna Convention on the Law of Treaties: "A treaty or part of a treaty is applied provisionally pending its entry into force if: (a) the treaty itself so provides or (b) if the negotiating states have in some other manner so agreed." The CTBT does not rule out provisional application and even during the negotiations over entry-into-force requirements, the idea of provisional application was discussed by many States as a way to prevent a handful of other States from exercising a veto. Thus the CTBT could take legal effect for those who wish to abide by the agreement. Though not binding on those who remain outside, the Treaty in provisional application would be more likely to act as a brake on further 'copycat' testing.

A major criticism leveled against provisional application of the CTBT is based on the apprehension that the United States, which contributes a fifth of the overall costs of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), may oppose this step and limit its funding to the organization. Such fears are exaggerated because any such decision to cut down funding to the CTBTO would be far more costly to Washington in terms of political influence against nuclear proliferation. Also, provisional application of the CTBT could be expected to tilt

Dust raised in the Ras Koh mountains from Pakistan's first nuclear test on 28 May 1998.

American public opinion in favour of ratification and place the U.S. Senate under additional pressure to ratify the CTBT. Once the United States ratifies the Treaty, the remaining holdout States will most likely be stimulated to follow suit due to the fear of being marginalized by choosing to remain outside of the Treaty.

Pakistan's nuclear security establishment remains steadfast in its stubborn position. Since May 1998, successive governments in Pakistan have tied their stance on the CTBT to New Delhi's future course of action. Pakistani analysts have frequently commented that in a nuclearized South Asia, the CTBT will have relevance only if both India and Pakistan are parties to the Treaty. In 1998, Pakistan responded to India's nuclear tests by conducting its own underground explosions and Pakistan fears that India even harbours plans to conduct additional nuclear tests in the future. But Pakistan has repeatedly made it clear that it will not be the first to resume nuclear testing in the region. Although it subsequently came under enormous pressure from the United States to accept the CTBT, the government in Pakistan maintained that its ratification would depend on India's future course of action. Despite many incentives, the United States failed to persuade Islamabad to ratify the CTBT.

CTBTO MEMBERSHIP OFFERS MANY BENEFITS

Some people, including myself, have argued on many occasions that if Pakistan joins the CTBT, it will be able to access CTBT monitoring data. In addition, if the nuclear establishment in Pakistan is really so obsessed with India's position, signing the CTBT would be the perfect tool to promote Pakistan's position as a responsible nuclear State willing to accept real restraints, unlike India. Pakistan's willingness to join the CTBT might also prove instrumental in securing cooperation in civilian nuclear technology from the United States and other major powers. Unfortunately, however, policymakers in Pakistan have never tried to think along these lines and some analysts even say openly that it would be suicidal to sign the CTBT .

The technological advances in the global nuclear test monitoring system have already made it easier to detect underground nuclear tests with a yield of even less than one kiloton. The CTBT's entry into force will also make on-site inspections possible. Over the past few years, the United States and Russia have spent billions of dollars on modernizing their nuclear forces. Thus the CTBT, after taking full legal effect, would be a major contribution to non-proliferation goals by restraining countries with nuclear weapons capabilities from further modernizing their nuclear forces.

BIOGRAPHICAL NOTE

RIZWAN ASGHAR
has worked as Visiting Fellow at the Monterey Institute of International Studies, California and Sandia National Laboratories, New Mexico, USA. Rizwan has published extensively on issues related to nuclear non-proliferation and international security.

Welcome back HA03

Robinson Crusoe Island

BY GEORGIOS HARALABUS
LUCIE PAUTET
JERRY STANLEY
AND
MARIO ZAMPOLLI

In 2010 a tsunami destroyed hydroacoustic station HA03 at Robinson Crusoe Island, Chile. HA03 is part of a global network of monitoring stations established by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). After a huge logistical and engineering undertaking which took four years and cost over US$ 20 million, HA03 is now back in operation.

THE HYDROACOUSTIC NETWORK

The hydroacoustic network is part of the International Monitoring System (IMS). When complete, the IMS will comprise 321 stations and 16 radionuclide laboratories to monitor the globe for evidence of a nuclear explosion. In order to provide uniform coverage, many stations are located in remote areas; this has posed engineering challenges unprecedented in the history of arms control. The IMS uses four complementary verification methods – hydroacoustic, seismic, infrasound and radionuclide monitoring – and incorporates the most modern technologies available.

As sound propagates very efficiently through water, only a few hydroacoustic stations are required to provide effective acoustic monitoring of the world's oceans, thereby ensuring that no nuclear explosion goes undetected. Ten of the 11 hydroacoustic network stations have already been certified as complying with the stringent technical requirements of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Of the 11 hydroacoustic stations, five are T-phase stations. They use seismometers to detect waterborne signals from acoustic events which couple to the Earth's crust in coastal areas. The other six are cabled stations that utilize hydrophones, like HA03. All the cabled stations have two triplets of underwater hydrophones suspended in the water column in a horizontal triangular configuration with a separation of two kilometres, except for HA01 at Cape Leeuwin which has only one.

The names and locations of the triplets for the cabled hydrophone hydroacoustic stations are shown in the table on page 19 (Figure 1). Station HA04 is to be installed in the Crozet Islands.

The deployment depth of the hydrophones changes with location; they are floated at the depth which provides optimal sound propagation conditions at each site. The three hydrophone configuration allows for a bearing estimation of the sounds detected. The

The installation vessel was a modern sub-sea telecommunications cable ship.

hydrophone sensors detect signals in the 1–100 Hz frequency range. The self-noise of the system is 10 decibels below ocean noise for a typically quiet ocean to maximize the detection range of the hydroacoustic network. The signals acquired from the underwater hydrophones of cabled stations generally pass through tens of kilometres of underwater trunk cable to a shore station and from there via a satellite link to Vienna.

HA03 AND THE 2010 TSUNAMI DEVASTATION

The Juan Fernandez archipelago is situated around 670 kilometres west of the Chilean mainland. There

LOCATION AND STATE RESPONSIBLE	STATION CODE	LATITUDE (DEG. N)	LONGITUDE (DEG. E)	HYDROPHONE DEPTH (M)	WATER DEPTH (M)
CAPE LEEUWIN, AUSTRALIA	HA01W	-34.892	114.153	1055	1558
JUAN FERNANDEZ ISLANDS, CHILE North triplet	HA03N	-33.449	-78.938	820	2000
South triplet	HA03S	-33.823	-78.846	810	2100
BIOT/CHAGOS ISLANDS, UK North triplet	HA08N	-6.342	71.014	1250	2300
South triplet	HA08S	-7.645	72.474	1350	1800
ASCENSION ISLAND, USA North triplet	HA10N	-7.845	-14.480	847	2005
South triplet	HA10S	-8.941	-14.648	860	1733
WAKE ISLAND, USA North triplet	HA11N	19.713	166.891	750	1400
South triplet	HA11S	18.508	166.702	750	1150

Figure 1. The CTBTO's hydrophone hydroacoustic stations and their triplets. HA04 is to be installed in the Crozet Islands.

Figure 2. The CTBTO's network of 11 hydroacoustic stations. Stations in red are the hydrophone cabled stations and those in black are the T-phase stations.

are three islands in this archipelago: Alejandro Selkirk, which is the largest and most westerly island, named after the castaway Scottish sailor who actually inspired Daniel Defoe's famous novel 'Robinson Crusoe'; the tiny uninhabited island of Santa Clara; and Robinson Crusoe Island where two CTBTO stations have been installed: hydroacoustic station HA03 and infrasound station IS14.

On 27 February 2010, a tsunami induced by an 8.8 magnitude earthquake hit the island and destroyed HA03 and the central recording facility (CRF) shared by the two stations (the other components of the infrasound station were not affected as they are located on the top of mountains hundreds of metres above sea level). The tsunami destroyed most of the coastal village of San Juan Bautista and claimed 16 lives. Four years later, in parallel with the re-building of the San Juan Bautista shoreline, the CRF and the hydroacoustic station have been fully re-established.

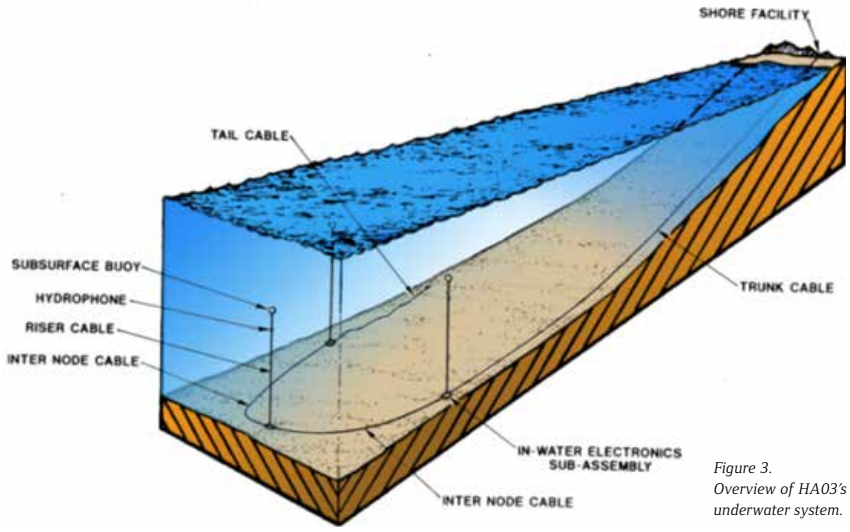
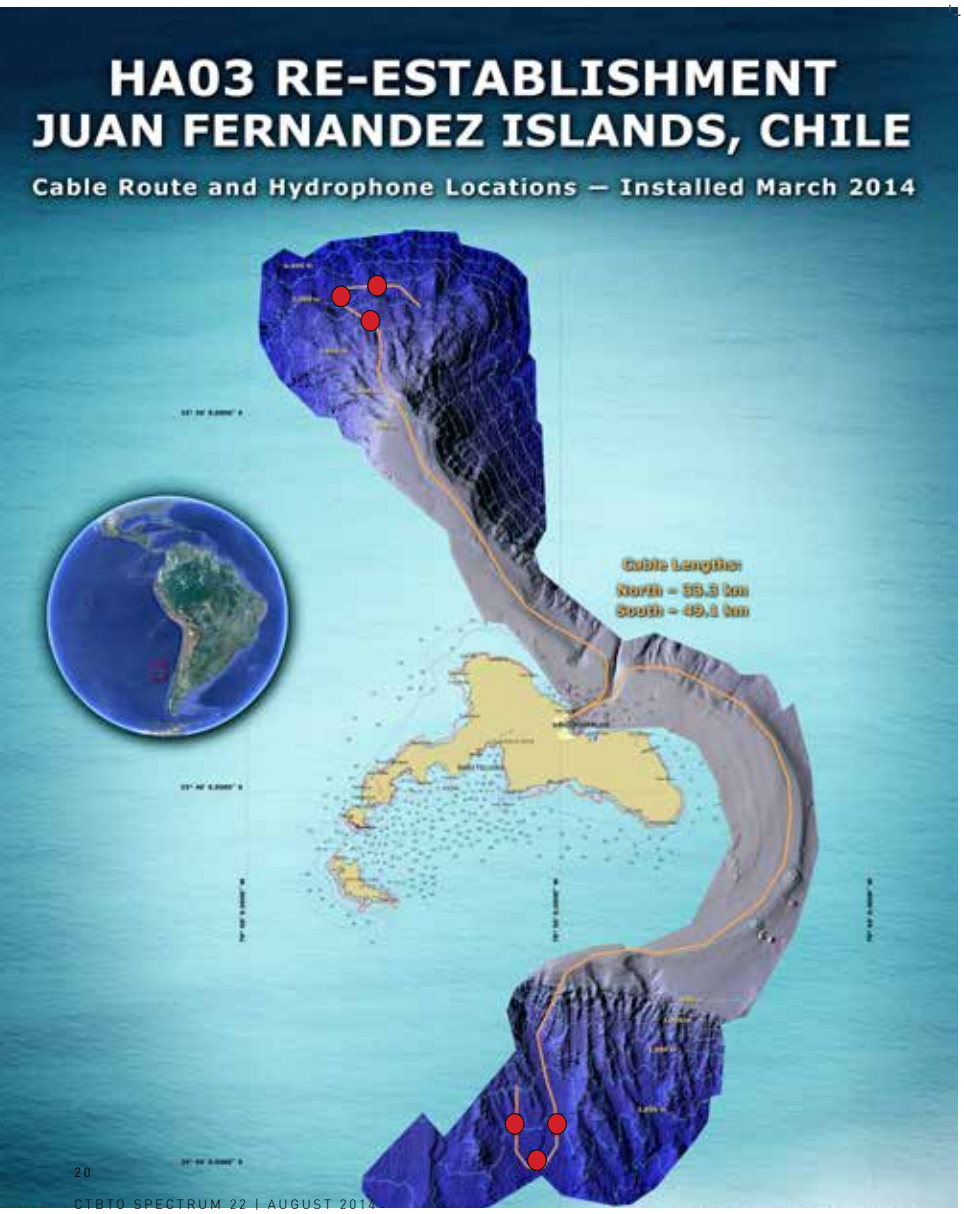


Figure 3.
Overview of HA03's underwater system.



THE RE-ESTABLISHMENT OF HA03 IN 2014

The installation of HA03 consisted of three main phases. First of all, a suitable plot of land for the CRF was identified in the village of San Juan Bautista; its relatively high elevation above sea level is important for tsunami risk mitigation. The CRF was installed in April 2013 and provides the data link for HA03 and IS14 to the CTBTO's International Data Centre (IDC) in Vienna.

The second phase entailed the manufacturing and integration testing of the HA03 system, which was completed in December 2013.

During the third phase from 26 February to 5 March 2014, the underwater system was deployed (see Figure 3).

Figure 4.
A schematic of the underwater cables and the position of the hydrophones with a map of the undersea topography around part of the island. The cables leading to the north and south hydrophone triplets (represented by orange lines) were 33 km and 49 km long respectively, with armouring and other protection applied to mitigate against risks from anchoring and local lobster fishing activities. The hydroacoustic moorings and the location of the hydrophones are represented by red dots.

Deployment of a hydrophone mooring in rough seas.

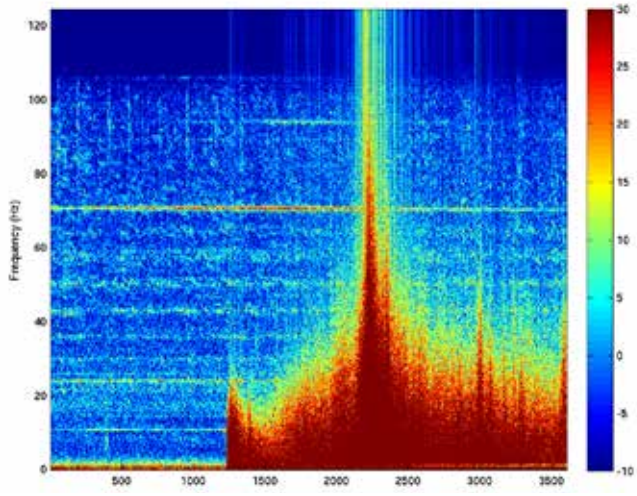


Figure 5.
Frequency content of the 1 April 2014 earthquake signal on an HA03 hydrophone versus time (in seconds) on the horizontal axis. The colour scale is in decibels (dB), with red colours denoting higher energy content.

The CTBTO's system acceptance testing took place immediately after HA03's installation and was completed on 10 March 2014.

Deploying a system of this kind at sea is a complex operation, which differs in many ways from standard undersea telecommunications cable deployment activities. It is a challenge even for the most modern cable ships and experienced teams. The installation was performed flawlessly by an experienced deployment team and the ship's crew who had to contend with some adverse conditions, such as rough seas and wind speeds of more than 30 knots (56 km/h) during some stages of the installation of the north triplet. Immediately after being connected to the CRF, HA03 started sending high quality data to the IDC in Vienna.

PERFORMANCE OF THE NEWLY ESTABLISHED STATION HA03

The quality of the data arriving from the new HA03 hydrophones has been assessed and monitored continuously since the hydrophone nodes touched down at their designated locations on the sea floor. This was made possible through the early real-time connection established during deployment between the station's shore equipment on the island, the underwater system, and the IDC in Vienna. Data from the IDC were sent back by satellite e-mail link to the installation ship and provided immediate feedback about the correct functioning of the system to the installation team.

From day one, HA03 detected a multitude of natural signals of interest, which made it possible to assess that the station was operating to the best of expectations. In addition to providing insights into the functioning of the station, the natural signals recorded are of wider scientific interest, and will be made available to researchers through the virtual Data Exploitation Centre (vDEC) system[1] at the CTBTO or their respective National Data Centres.

One major natural event detected by the newly installed HA03 was the 8.2 magnitude earthquake which occurred on 1 April 2014 in Northern Chile. The first of the fast seismic waves travelling through the Earth's crust below the ocean and leaking acoustic energy into the water can be seen reaching the hydrophone at approximately 1300 seconds in Figure 5. Most of the acoustic energy was contained in the sound radiated from the epicentre into the water near the coast which arrived later at approximately 2200 seconds. The waterborne sound generated by the earthquake was observed by HA03 to come from exactly the direction predicted on the basis of the event's epicentre.

In addition, a large number of underwater explosion-like signals arrived

[1] vDEC is a platform that enables researchers to access archived monitoring data and processing software

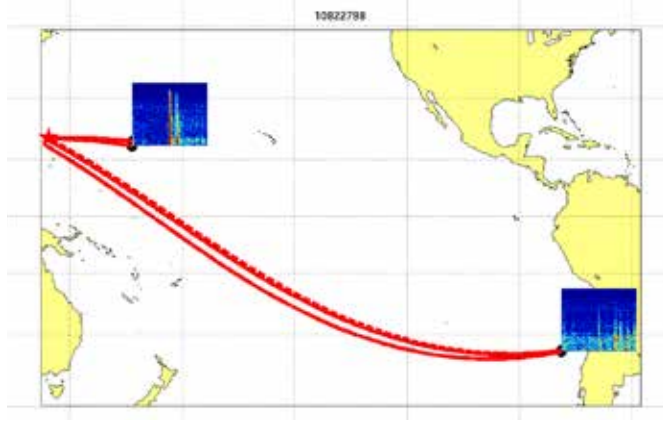


Figure 6.
Frequency content of the hydrophone recordings at HA03 and HA11 pertaining to bursting underwater gas bubbles emitted by an undersea volcano near the Mariana Islands. The paths (in red) indicate the path travelled by the sound to reach the stations.

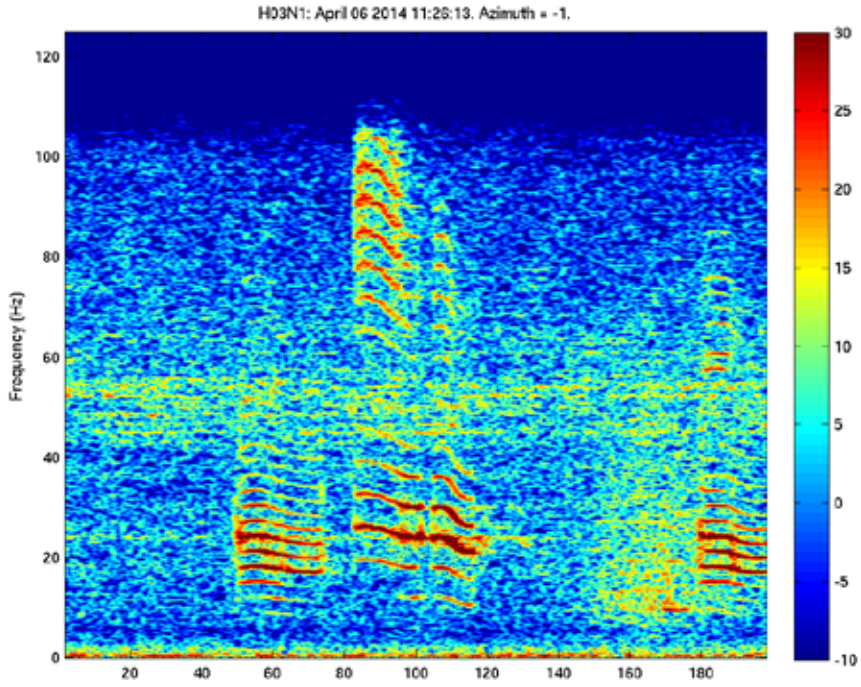


Figure 7.
A spectrogram of a whale's 'song' recorded by HA03.

at HA03 and were registered by the IDC in April 2014. These sounds were generated by bursting underwater gas bubbles emitted by an undersea volcano near the Mariana Islands in the North Pacific Ocean, 15,000 km from Robinson Crusoe Island (see figure 6).

The ocean around Robinson Crusoe Island is characterized by the strong presence of large whales. The whales' calls are in the frequency band of the hydroacoustic station (see Figure 7). Whales swimming towards the hydrophone triplets have been tracked by determining the direction of their calls.

Systematic checks to confirm the correct functioning of the station are conducted on a continuous basis. These checks evaluate the background noise levels recorded by the hydrophones and are compared against average ambient noise curves for the oceans. They are also used to compare HA03's performance with other hydrophone stations.

A MAJOR FEAT FOR THE CTBTO

The reconstruction of HA03 means large parts of the South Pacific Ocean are once again monitored by the station. This major accomplishment for the CTBTO has been made possible through the continuous support of the organization's Member States.

In cooperation with United Nations Television, the CTBTO is producing a video on how its dedicated staff completed the complex and demanding reconstruction of HA03, a station located in one of world's most remote and fascinating islands.

BIOGRAPHICAL NOTES

GEORGIOS HARALABUS
is the Head of the Hydroacoustic Unit at the CTBTO's International Monitoring System (IMS) Division. He joined the CTBTO in 2009. Prior to this he worked for 13 years as Programme Manager at the NATO Centre for Maritime Research and Experimentation in Italy, mainly for the development of Environmentally Adaptive Sonar Concepts. Dr Haralabus is a Fellow of the Hellenic Institute of Acoustics and a member of the European Acoustics Association.

LUCIE PAUTET
is a Hydroacoustic Officer with the CTBTO's IMS Division. She returned to the CTBTO in 2013 after having served in the Division as a Maintenance Officer and Hydroacoustic expert from 2006 to 2010. Dr Pautet was previously the Associate Director for Engineering on the cabled ocean observatory NEPTUNE Canada. She also worked as a scientist at the NATO Centre for Maritime Research and Experimentation in Italy.

JERRY STANLEY
is a Hydroacoustic Officer/ Project Manager with the CTBTO's IMS Division. He joined the CTBTO in 2011 after 10 years working in international maritime consultancy. Dr Stanley was previously the Chief Scientist at the UK's Maritime and Coastguard Agency. Prior to this he was a Technical Manager and an Operational Analyst in the maritime defence sector.

MARIO ZAMPOLLI
is a Hydroacoustic Officer/ Engineer with the CTBTO's IMS Division. He joined the CTBTO in 2012 after 11 years at the NATO Centre for Maritime Research and Experimentation in Italy and The Netherlands Organization for Applied Scientific Research. In 2010 Dr Zampolli was awarded the A.B. Wood Medal by the Institute of Acoustics. He is a Fellow of the Acoustical Society of America.

The science of sound:

How 'soundscapes' can help us understand the underwater world

BY MARK PRIOR

Devices that listen for underwater sounds generated by nuclear tests can be used to describe the 'soundscape' of noises produced by whales, breaking ice, earthquakes and volcanoes.

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban-Treaty Organization (CTBTO) operates the International Monitoring System (IMS): a worldwide network designed to detect signals caused by nuclear test explosions. The IMS will consist of 337 facilities when complete; almost 90% of these facilities are already operational. The network has seismometers to detect vibrations in the Earth, microphones to listen for very low frequency sounds in the air (infrasound) and radiation sensors that 'smell the air' for radioactive gases and particles produced by nuclear explosions. The IMS also uses underwater microphones (hydrophones) to detect sound in the ocean. Since water is an excellent sound conductor – sounds can travel over four times faster through water than air and can also be detected at greater distances - the IMS hydroacoustic network comprises just 11 stations. These stations monitor all of the world's oceans.

PROCESSING DATA 24/7

IMS hydrophones are attached to shore stations by cables that can be up to 100 kilometres (km) long. These cables provide power and are connected to a satellite link that sends data to the International Data Centre (IDC) at the CTBTO's headquarters in Vienna, Austria. Each cable lies on the seabed and three hydrophones are floated up from it. The hydrophones are arranged in a triangle, two km apart at a depth of about 1,000 metres. This shape allows the arrival time of signals to be measured, along with the direction from which they arrive. Time and direction data are used to calculate the times and locations of the events that produced the signals. Events detected by the IMS network include earthquakes, volcanoes and mining blasts, as well as nuclear test explosions. Data from the IMS are processed at the IDC 24 hours a day and a list of events is produced for every day of the year.

Installation of hydroacoustic station HA11, Wake Island, USA.

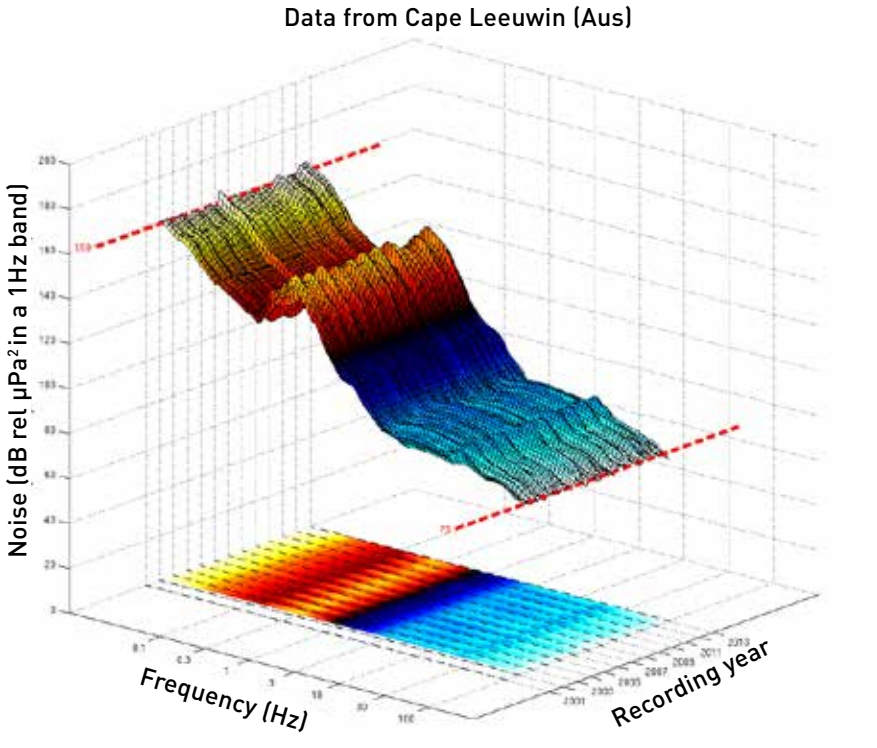


Figure 1: Soundscape for the IMS hydrophone station off Cape Leeuwin, Western Australia.

DESCRIBING HOW THE UNDERWATER WORLD SOUNDS

To understand how well the IMS hydrophone sensors are working, and to help predict how this might change in the future, the CTBTO produces 'soundscapes'. These are descriptions of how the underwater world sounds, in the same way that a 'landscape' is a description of how the Earth's surface looks. Two different descriptions are used. The first shows how the strength of sound changes with frequency and time. The second shows the directions from which signals arrive.

Figure 1 shows noise data measured at the IMS station Cape Leeuwin, off the coast of Western Australia. Data are shown for the entire period since the station started, with noise levels calculated for frequencies between 0.01 Hertz (Hz) and 100 Hz (human hearing covers an approximate frequency range between 20 Hz and 20,000Hz). The height and colours of the surface in the figure are set by the noise in decibels, relative to one micropascal, which scientists use as the reference value for underwater sound pressure levels. The 'carpet' on the floor of the figure shows the same data 'flattened out' so that only the colour shading is left. This is done because some features in the data are clearer in the flat image, while others show up better on the surface. The underwater noise levels in the figure should not be confused with values quoted for airborne sounds made by rock concerts or jet engines. Different reference levels are used for airborne sounds and the numbers cannot be directly compared.

THE ORIGIN OF 'OCEAN MICROSEISM'

The ridge in the surface that runs through all years at a frequency of 0.3 Hz is made by sounds produced by water waves on the sea surface. These waves make noises that travel down towards the seabed. The sound waves hit the seafloor and make vibrations in the Earth's crust. These vibrations – known as 'the ocean microseism' – are seen even in the middle of continents, thousands of kilometres away from the coast. The bright yellow patches in the 'carpet' in the figure show that the peaks along the ridge happen in the southern-hemisphere winter, when the southern Indian Ocean is roughest.

The surface in Figure 1 shows small 'hills' at frequencies around 20 Hz in the early months of each year. These hills are caused by whale calls that are heard at Cape Leeuwin during the yearly migration of fin and blue whales.

The data shown in Figure 1 are useful when working out how sensitive each hydrophone station is. The quietest signal that a station can detect is controlled by the noise in the frequency band containing the signal. The figure shows how this changes as the source of the noises (ice-breaking, whales, storms etc.) varies through the year.

Although plots like Figure 1 are very useful, they do not show important information about the direction from which signals arrive. A second, separate plot is used for this and an example is shown in Figure 2.

Figure 2 shows the directions from which signals arrived at the Cape Leeuwin station during the year 2010. For each day, a grey dot is drawn in the figure for 360 directions moving clockwise from north to south then back up to north again. Light-grey or white dots show directions and days on which many arrivals were seen. The map to the right of the figure is a 'Cape Leeuwin's eye view' of the world, where continents are placed according to their direction and distance from the station. The "stretching" according to direction and distance from Cape Leeuwin is responsible for the warped appearance of the map. The blue lines in the map show mid-ocean spreading ridges. These are places where earthquakes are common.

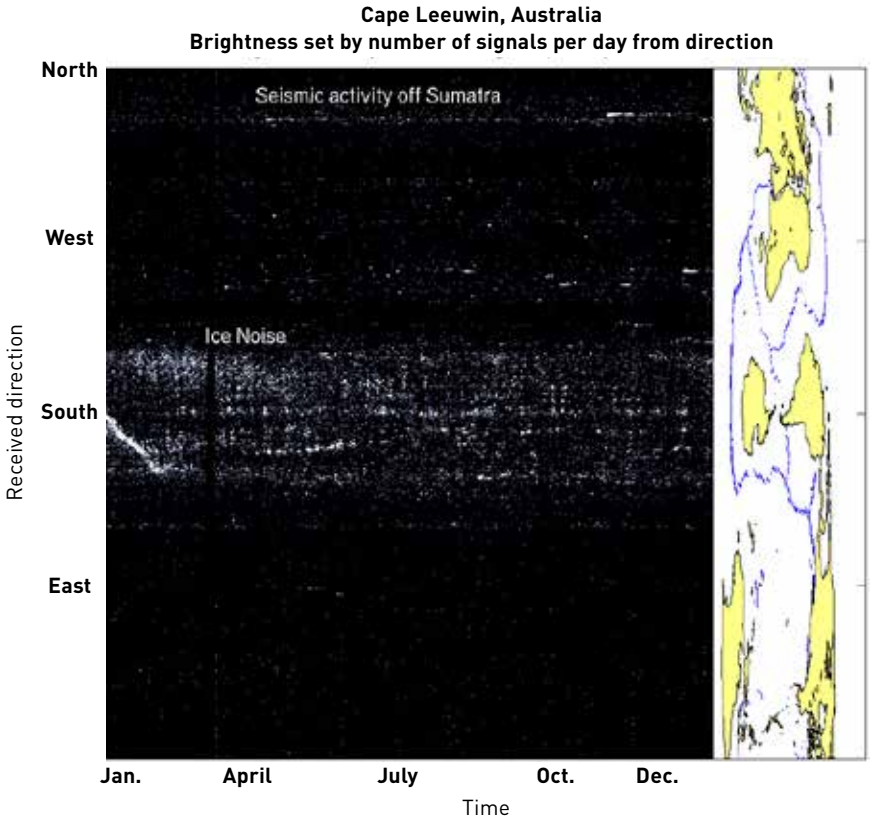


Figure 2:
The directions from which sound arrives at the IMS hydrophone station off Cape Leeuwin, Western Australia.

IDENTIFYING ICE NOISE AND T PHASE SIGNALS

The broad, grey stripe in Figure 2 shows that signals arrive at Cape Leeuwin from the south all year round. The map region matching this stripe covers Antarctica and this helps to identify ice noise as the source of many of the arrivals. Inside the broad stripe, thinner, brighter lines can be seen. These are caused by single, drifting icebergs that leave Antarctica and move with ocean currents, breaking up as they melt.

The thin, grey line near the top of the figure shows a direction to the northwest of the station from which signals arrive throughout the year. The map shows that this direction points to the coast of Indonesia where there are many earthquakes. These signals are called T-phases and are noises in the ocean made when earthquakes make the coast or underwater mountains shake. Towards the end of the year, Figure 2 shows a bright line just above the thin stripe. This line begins suddenly then gradually fades from white, through grey to black.

This type of feature is made by large earthquakes and the aftershocks that follow them. In this case, the line in Figure 2 was made by a magnitude 7.7 earthquake on 25 October 2010 off the west coast of Sumatra in Indonesia. This earthquake caused a 3-metre-high tsunami and killed over 400 people. Data from the IMS, including hydrophone stations, which are currently sent to 11 tsunami warning centres around the world, helped to produce a tsunami warning that was sent on the day of the earthquake that caused the line in Figure 2.

SOUNDSCAPES OFFER A RANGE OF BENEFITS

Soundscapes help the CTBTO to understand the current performance of their hydrophone stations. Trends in noise that show up in the soundscapes also help to predict how station performance might change in the future. Furthermore, the information contained in the soundscapes is useful to scientists involved in areas outside nuclear test-ban monitoring. For example, the level of microseism sound is related to sea surface roughness and this can be useful to scientists interested in climate modelling. Ice-breaking noises received from Antarctica are of interest to polar scientists studying changes in ice-cover; and whale noises recorded on CTBTO hydrophones can be used by scientists studying marine mammal behaviour. These and many other scientific fields can all benefit from the pictures of the ocean soundscape that can be built from the data provided by the hydrophone stations of the International Monitoring System.

This is a popular version of a Paper that was presented on 5 December 2013 at the 166th Meeting of the Acoustical Society of America, San Francisco, USA.

The views expressed in this paper are those of the author and do not necessarily represent the views of the CTBTO Preparatory Commission.

BIOGRAPHICAL NOTES

MARK PRIOR
is a seismic/acoustic officer at the International Data Centre of the CTBTO where he has worked since 2007. He has worked in the field of underwater acoustics since graduating from university and has previously studied oceanography and sonar design. Before joining the CTBTO Dr Prior worked at the NATO Undersea Research Centre in La Spezia, Italy, and prior to that in Dorset, England.

ON-SITE INSPECTION

IFE14

JORDAN الأردن

AT A GLANCE

The Integrated Field Exercise 2014 IFE14

ULTIMATE VERIFICATION MEASURE

Under the Comprehensive Nuclear-Test-Ban Treaty (CTBT), an on-site inspection (OSI) is the ultimate and most powerful verification measure. Up to 40 inspectors search a defined area for evidence of a nuclear explosion, using a wide range of activities and techniques.

An OSI can only be launched after the CTBT has entered into force. In preparation for that day, the CTBTO regularly conducts OSI exercises to fine-tune its procedures and techniques.

The Integrated Field Exercise 2014 – IFE14 – is the second full scale simulation of all phases of an OSI under realistic and challenging conditions. The first such simulation – IFE08 – took place in Kazakhstan in 2008.

OBJECTIVE

The main goal of IFE14 is to evaluate the progress made regarding the CTBTO's operational capability to conduct an OSI and to further refine this capability.

SETTING

IFE14 will take place in Jordan's Dead Sea region from 3 November to 9 December 2014 in an inspection area of almost 1,000 km^2.

PARTICIPANTS

Over 200 experts from the CTBTO and its Member States will fulfil functions within the inspection team, the operations support centre, the inspected State Party, the control team, the exercise management team and the evaluation team.

In order to provide Member States with the possibility to observe IFE14 activities, both a VIP visit and various observer programmes will be arranged.

THOROUGH PREPARATION

The four individual phases of an OSI were practiced in three separate build-up exercises during 2012 and 2013.

Training of experts from the second training cycle as 'surrogate' inspectors as well as additional training in preparation for IFE14 amounted to a total of 28 weeks.

Two OSI workshops in 2012 (Austria) and China (2013) were dedicated to identifying lessons in relation to the build-up exercises and preparations for IFE14.

REALISTIC & CHALLENGING SCENARIO

The OSI simulation will be based on a complex, scientifically credible and challenging scenario developed and peer-reviewed over a period of two years with the support of the CTBTO's Member States.

LOGISTICS: A HERCULEAN TASK

Several Member States are providing the CTBTO with high-end inspection equipment as contributions in-kind. The respective agreements have been concluded and most of the equipment is already in Vienna for final testing and training.

Around 150 tons of equipment including sensitive and dangerous goods will be dispatched from Austria to Jordan.

HEALTH AND SAFETY: TOP PRIORITY

A comprehensive health and safety plan for IFE14 is being developed and provisions for the medical examination of IFE14 participants are currently being implemented.

STRINGENT EVALUATION

IFE14 will be evaluated by an independent team of experts from Member States in order to identify lessons for further improvement.

CTBTO.ORG/IFE14 #IFE14

The second integrated field exercise: Taking OSI capabilities to the next level

BY GORDON MACLEOD AND MATJAZ PRAH

Exercises have always played a central role in the development of the on-site inspection (OSI) element of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification regime. The same applies to other multilateral verification mechanisms such as Chemical Weapon Convention inspections.

A verification mechanism as complex as an OSI requires testing in an integrated manner so that the Member States of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) have confidence in its effectiveness.

Think of a car: all of the parts can be designed and built separately (engine, wheels, brakes, gearbox etc.) but if they are not put together and tested in an integrated manner, there is no guarantee that the car will function correctly and safely. For an OSI, an additional layer of complexity derives from the human interaction and interpretations of the Treaty, Protocol, and Operations Manual as well as the perceptions, interpretations and actions of the individual inspectors. An integrated field exercise (IFE) provides the environment in which to test the integration of all operational and technical elements of an OSI.

In 2008 the CTBTO conducted its first Integrated Field Exercise – IFE08 – at the former Soviet Union's nuclear test site at Semipalatinsk in Kazakhstan. IFE08 was the final stage of the first development cycle of the OSI verification element. The lessons learned from IFE08 provided the basis for the 2010–2013 OSI Action Plan, which has been successfully completed to further develop OSI operational capabilities.

The next IFE will take place at the end of this year in Jordan, near the Dead Sea. Its main

TRAINING ACTIVITIES CONDUCTED FOR THE INTEGRATED FIELD EXERCISES	IFE08	IFE14
Introductory course	2 weeks	2 weeks
Advanced course	2 weeks	3 weeks
Health & safety course	0	1 week
Leadership course	1 week	1 week
Technical courses and tabletop exercises	2 weeks	10.5 weeks
Operation support centre training	< 0.5 week	0.5 week
Host country training	0	1 week
Final preparatory course	0	2 weeks
Build-up exercise courses	0	5 weeks
Field training exercise	0	Build-up exercise III/ field training exercise (2 weeks)
Total number of weeks	Approx. 7 weeks	Approx. 28 weeks

aim will be to test the level of operational capabilities and technical advancements achieved since IFE08.

There have been a number of different approaches when preparing for these two major events. These have been primarily in the areas of training, documentation, preparatory exercises, methodology and techniques, as well as logistics. The CTBTO and its Member States have invested considerably in both IFE08 and IFE14.

FOUR TIMES AS MUCH TRAINING

Preparations for IFE08 consisted of a 13-week training cycle that was eventually reduced to around seven weeks due to budgetary constraints. The training covered:

1. An introductory training course for all future (= surrogate) inspectors.
2. Five parallel advanced training courses for the inspection sub-teams.
3. Specialized training for exercise participants with leadership roles which included a table-top exercise.

Comprising a total of 28 weeks, preparatory training for IFE14 was four times longer than for IFE08. New elements included an entire week of health and safety training including radiation protection, training for the host country representatives who will assume the role of the inspected State Party, and a field training exercise.

Equipment handling during IFE08 – a good workout but not really efficient.

Equipment handling during Build-Up Exercise III in 2013 – will also be used during IFE14.

EXERCISES CONDUCTED IN PREPARATION FOR IFE08 AND IFE14	IFE08	IFE14
Directed exercises	2	2
Field tests	3	10
Build-up exercises	0	3

»IFE08 was only a test drive around the block – now we're headed for the Autobahn.«

DOCUMENTATION

Based on lessons learned during IFE08, special attention has been given to developing the documentation system. The number of documents for IFE14 already stands at 92, compared to 14 for IFE08 (excluding equipment user manuals).

INNOVATION: BUILD-UP EXERCISES

Before IFE08, the main vehicles for developing different OSI techniques were directed exercises. These are small to medium scale events to test the operations and techniques of one or two specific elements of the OSI verification regime at a time. The two directed exercises in preparation for IFE08 were devoted to building up the logistical capabilities and practising certain OSI techniques such as airborne magnetic field mapping, visual observations or gamma radiation surveys.

In the run-up to IFE14, a series of field tests have been conducted to test equipment and develop the operational capabilities of specific techniques, for example multispectral imaging including infrared (MSIR) system. The main innovation for IFE14 has involved carrying out build-up exercises (BUEs), which test entire phases of the OSI inspection in an integrated way. To save costs, the three BUEs for IFE14 were conducted in Austria and Hungary.

LOGISTICS

Progress since IFE08 is evident in the field of logistics. The base of operations' set up has been further refined to ensure smooth operations and now features a comprehensive radionuclide and noble gas laboratory. As a result of the upgrade in the inspection equipment that is available to the CTBTO, around three times more equipment (150 tons) will be shipped to Jordan than was dispatched to Kazakhstan in 2008. The equipment is also easier to access. Most OSI equipment is already being stored in Vienna in special air freight containers that have been specially developed for an OSI. These Intermodal Rapid Deployment System containers allow for field equipment, servers or generators to be used straight from the containers. Other organizations with similar mandates have started to emulate the CTBTO's OSI logistic system.

VSAT antenna used for IFE08 (2.4 metres, heavy, six hours to install)

VSAT antenna to be used during IFE14 (30 minutes to deploy, light, field VSAT antenna)

Comparison of inspection activities and technologies tested during IFE08 versus those planned for IFE14

INSPECTION ACTIVITIES AND TECHNIQUES #	PLAYED IN IFE08 (FULLY/LIMITED/NOT PLAYED)	AVAILABILITY FOR IFE14 (FULLY/LIMITED/NOT PLANNED)
Position finding from the air and surface	Fully played	Fully available
Visual observation from the air, at and below the surface	Fully played (ground visual observation not developed)	Fully available
Video from the air, at and below the surface	Not played	Fully available
Still photography from the air, at and below the surface	Fully played	Fully available
Multi-spectral imaging including infrared measurements from the air, at and below the surface	Not played	Fully available
Measurements of levels of radioactivity above, at and below the surface using gamma radiation monitoring and energy resolution analysis from the air, and at or under the surface	Limited play (contribution in-kind equipment not in accordance with specifications of the CTBTO's Working Group on verification)	Fully available
Measurements of the noble gas argon-37	Not played (demonstration only)	Fully available
Measurements of radioxenon	Not played	Fully available
Environmental sampling and analysis of solids, liquids and gases from above, at and below the surface	Limited play	Fully available
Passive seismology	Fully played (30 stations)	Fully available (full set of 50 stations)
Resonance seismometry	Not played	Not planned (not envisaged as part of Action Plan)
Active seismic surveys	Not played	Available – limited usage
Magnetic field mapping from the air and at the surface	Limited play (contribution in-kind equipment)	Available – limited usage
Gravitational field mapping	Not played	Fully available
Ground penetrating radar	Limited play	Fully available
Electrical conductivity measurements	Limited play	Fully available
Drilling	Not played	Not planned (not envisaged as part of Action Plan)

LOGISTICAL ELEMENTS OF IFE08 AND IFE14	IFE08	IFE14
Base of operations	Simple design, included accommodation	Very complex design does not include accommodation
Tons of equipment	51.2	~150
Power system	Two 40KVA generators (for IT), two 40KVA generators (for other parts of the base of operations)	Integrated 220 KVA UPS dual 110 KVA generators system
Shipping	7 x 40ft ISO containers	27 Intermodal Rapid Deployment System containers and 3 aircraft pallets to be shipped by air, 10 x 20ft containers to be shipped by sea
Handling equipment	3 simple field non-motorized pallet movers	2 simple field non-motorized pallet movers 1 motorized forklift 1 bobcat multifunctional vehicle
Communications equipment	2.4 m Parabolic Hard Dish VSAT (Type used also in IMS stations), 40 analog UHF radios, spot trackers, Broadband Global Area Network (BGAN) satellite communication system, Iridium satellite phones	Portable, fast deployable inflatable GATR VSAT, 80 digital UHF radios, 7 hybrid mobile UHF/VHF/HF systems, one stationary base of operations hybrid UHF/VHF/HF including a full dispatcher

IFE14: CTBTO'S LARGEST AND MOST TECHNOLOGICALLY ADVANCED SIMULATED OSI

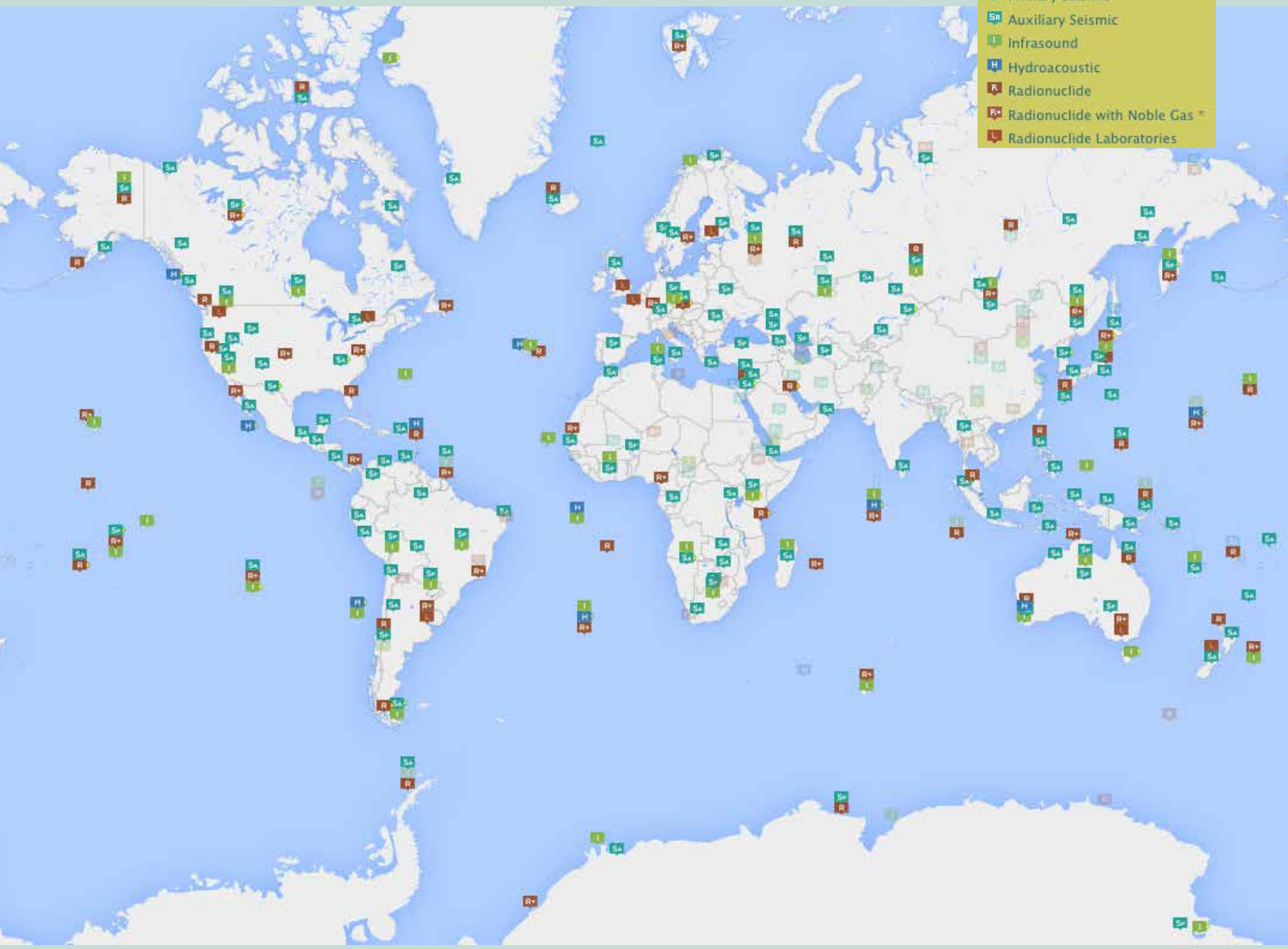
A number of valuable lessons were learned during IFE08 which were incorporated into the OSI Action Plan for 2010–2013 and have provided the basis for further development, especially in the areas of training and procurement. The whole concept of operation for IFE14 will be different to IFE08 as the pool of techniques and equipment available will be much larger. Cross-cutting issues like health and safety procedures, inspection team functionality, data flow and data security, geographical information system and communications are much more advanced than they were in 2008. While IFE08 was unprecedented at the time in terms of the scope and dimension of the exercise, IFE14 will be the largest and most technologically advanced simulated OSI ever conducted by the CTBTO and will demonstrate the progress made since 2008.

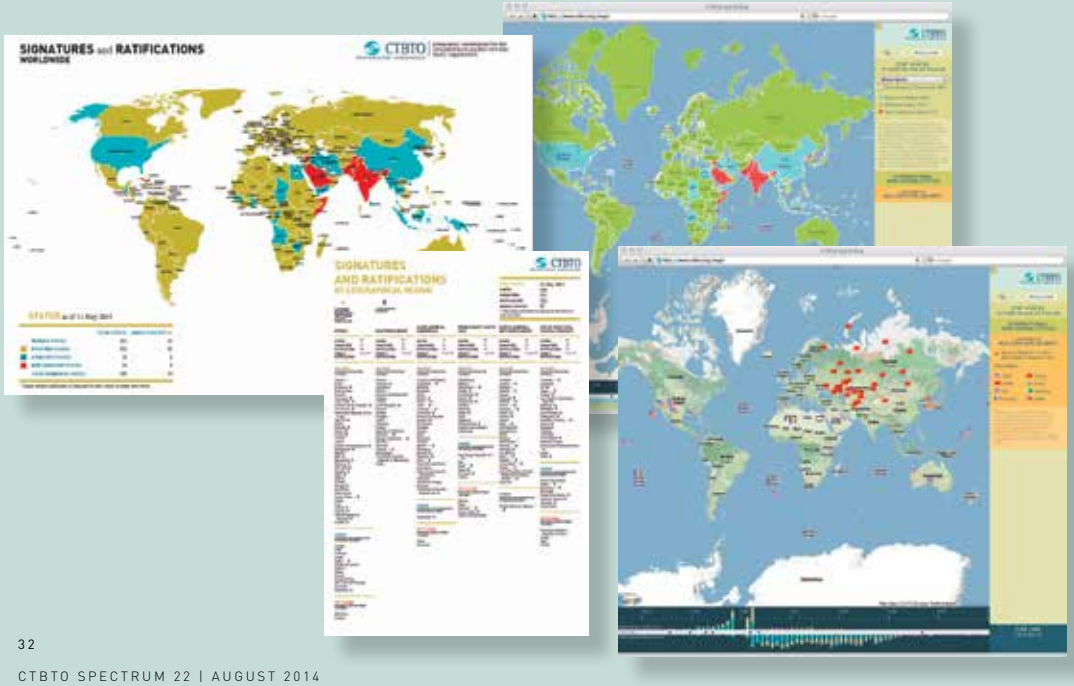
BIOGRAPHICAL NOTES

GORDON MACLEOD
is the Project and Exercise Manager for IFE14 and the Chief of Policy Planning and Operations within the On-Site Inspection (OSI) Division of the CTBTO. He has been involved in nuclear security and non-proliferation for nearly 30 years. Most of this time was spent at the Nevada National Security Site (Nevada Test Site). He was involved with the CTBT from a national perspective during negotiations in 1993 and joined the CTBTO in 2011.

MATJAZ PRAH
is the Coordinator of the OSI Division. He has spent nearly 25 years in the field of nuclear safety and security. He was Licensing Manager at the Krško Nuclear Power Plant in Slovenia and Director General of the Croatian National Nuclear Safety and Security Regulatory Body. He was also Chairman of the National Authority for CTBT implementation in the Republic of Croatia. He joined the CTBTO in 2009.

STATUS OF CERTIFIED IMS FACILITIES
AS OF 15 AUGUST 2014





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ART AND NUCLEAR TESTING

Featuring Doug Waterfield

In the 1950s, the U.S. Department of Energy (formerly known as the Atomic Energy Commission) began testing atomic bombs at the Nevada Test Site (NTS), rocketing America into what became known as the Atomic Age. At the same time, the Atomic Energy Commission built several "Survival Towns" also known as "Doomtowns" at the NTS. These were recreations of what was considered to be the quintessential American town, populated by mannequins, and then lit up by atomic blasts to see what the effects would be. The photos and film footage that survive from these tests were quite influential on my painting series, also entitled "Doomtown". The series deals with atomic tests as well as the paranoia, acknowledgement, and eventual acceptance of the Bomb and its insertion into American popular culture.

One of the driving forces behind my work is educating the public – bringing awareness to a forgotten part of our past. I don't want to take a political view on the morality of atomic testing – people already know what to think of that. I want to take this little known aspect of our history as a world power and shed a little light on it.

Doug Waterfield
has been an art professor since 2000. He is currently a Professor of Art at the University of Nebraska at Kearney, USA. He also serves as Department Chair. Waterfield's artwork has been shown nationally for the past 25 years. Most recently his 'Doomtown' painting series was exhibited at the National Nuclear Science Museum in Albuquerque and the National Atomic Testing Museum in Las Vegas.

THE INTERNATIONAL DAY AGAINST NUCLEAR TESTS 29 AUGUST 2014

In December 2009, the United Nations General Assembly declared 29 August as the International Day against Nuclear Tests. The day was proposed by Kazakhstan as it marks both the closure of the former Soviet Semipalatinsk Test Site in 1991 in modern-day Kazakhstan and the date of the first Soviet nuclear test conducted there in 1949.

The International Day against Nuclear Tests aims to raise public awareness and prevent more of the "devastating and harmful effects on the lives and health of people and the environment" caused by nuclear testing.

To mark the International Day against Nuclear Tests on 29 August 2014, a reception is being organized in the Rotunda at the Vienna International Centre, Vienna, Austria, from 13:00 to 14:00 by the Permanent Mission of Kazakhstan to the international organizations in Vienna.

The reception will take place on the final day of a five-day exhibition of the 'Doomtown' painting series by the artist Doug Waterfield in the Rotunda. The exhibition will also feature material by Kazakhstan's ATOM Project, the international campaign to create awareness about the human and environmental devastation caused by nuclear testing.

Paintings from the 'Doomtown' series

BY DOUG WATERFIELD

Doomtown X: Mannequins in the Desert: Operation Cue

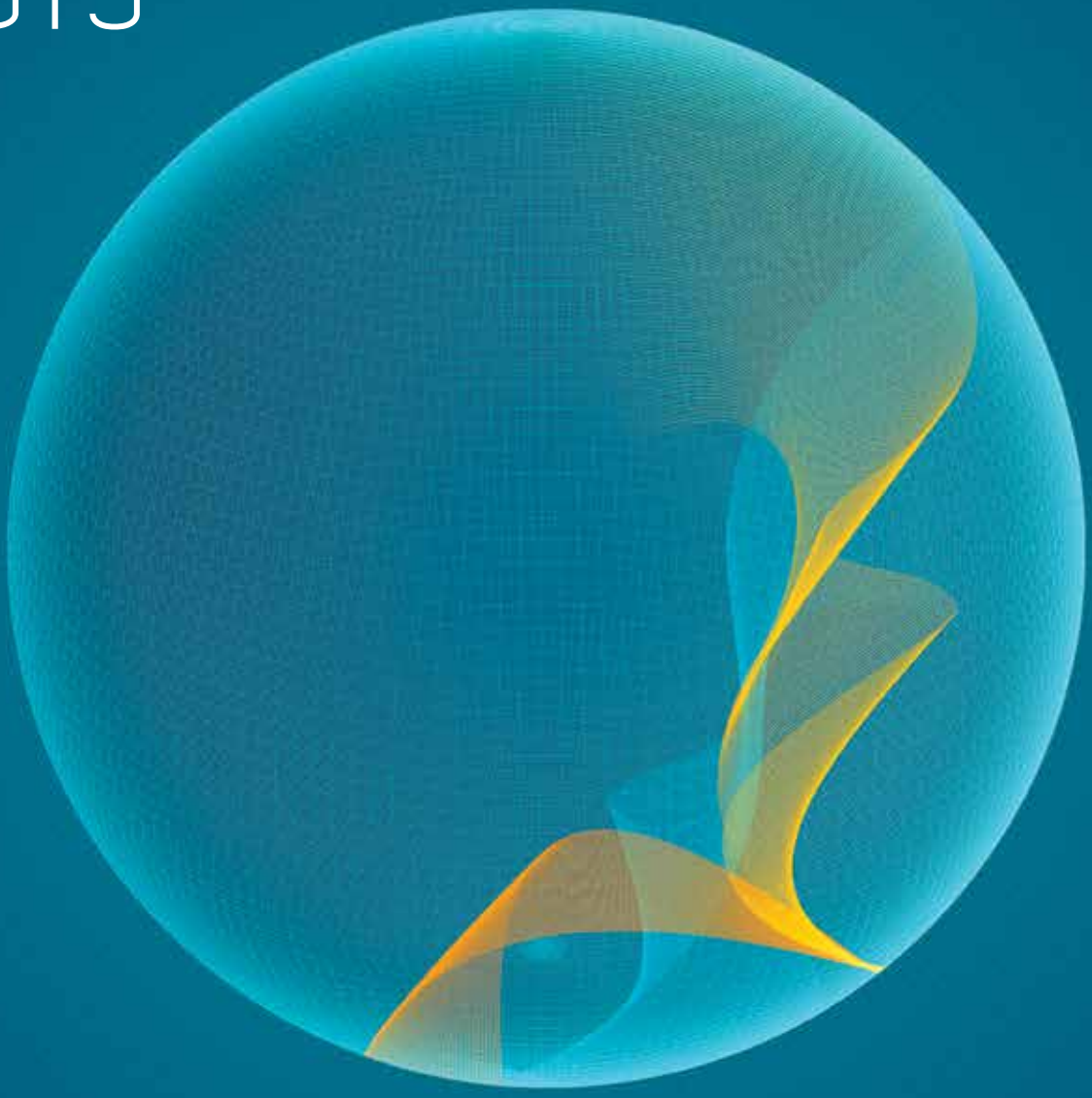
Doomtown XIX:Bikini Shot Spectators

Doomtown IX: Apple II Sequential House Explosion

CTBT: SCIENCE AND TECHNOLOGY 2015

THEMES

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



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