CTBTO SPECTRUM

24

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CTBTO PREPARATORY COMMISSION

PUTTING AN END TO NUCLEAR EXPLOSIONS

FOREIGN MINISTER OF JAPAN

FUMIO KISHIDA

FOREIGN MINISTER OF KAZAKHSTAN

ERLAN IDRISSOV

EU HIGH REPRESENTATIVE FOR FOREIGN AFFAIRS AND SECURITY POLICY

FEDERICA MORGHERINI

FORMER UN HIGH REPRESENTATIVE FOR DISARMAMENT AFFAIRS

ANGELA KANE

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

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

As of September 2015, 183 countries had signed the Treaty and 164 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 4 September over 85 percent of the facilities at the International Monitoring System (IMS) were operational.

THIS ISSUE'S COVER

Mushroom cloud wants to destroy human spring

by Renzou Zhan

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LASSINA ZERBO
CTBTO EXECUTIVE SECRETARY

In Japan last month at the solemn 70th commemoration of the bombings of Hiroshima and Nagasaki and again at the meeting of the Group of Eminent Persons (GEM), I had the privilege and opportunity to meet with several "Hibakusha", such as Keiko Ogura who was eight years old in 1945. Her testimony, like that of all survivors, moved me and all those who listened to her and it strengthened our resolve to work harder to rid the world of nuclear weapons once and for all. During my visit, I also had the opportunity to meet Ari Beser, a journalist who is using his own family history to investigate and report on what happened 70 years ago – and is drawing his own, sometimes surprising, conclusions on ways to achieve a more peaceful and more hopeful future. A sample of his writing is in this issue.

The over 2,000 nuclear tests conducted during the Cold War paved the way for the development of weapons that dwarf the Hiroshima and Nagasaki bombs in explosive power. A powerful tool to visualize this difference is the Nukemap by U.S. nuclear weapons historian Alex Wellerstein, who explains his motivation in creating such a unique online tool in this issue. Continuing this issue's excursion into history, German physicist Michael Büker explores a little-known aspect of one of the first nuclear tests conducted after the World War, the fate of the warships used as targets in the 1946 Baker underwater nuclear test at Bikini Atoll.

Populations downwind from test sites around the world paid with their health and often their lives. One of the most affected areas was Semipalatinsk in today's Kazakhstan. 29 August marks the day of the first nuclear test at Semipalatinsk, as well as the site's closure in 1991 by the newly independent Kazakhstan. At the country's initiative, by virtue of a resolution of the United Nations General Assembly the date is commemorated since 2010 as the International Day against Nuclear Tests.

On the occasion of this international day, United Nations Secretary-General Ban Ki-moon stated that "the best way to honour the victims of past tests is to prevent any in the future". In this context, 29 August serves as reminder that banning nuclear testing remains unfinished business.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT), in spite of enjoying near-universal support, is not yet legally binding due to its exceptionally demanding entry into force clause, which prescribes that all 44 countries listed as nuclear technology holders must ratify[1].

It is highly symbolical that Japan and Kazakhstan will jointly lead international efforts to bring the CTBT into force by chairing the Article XIV Conference on 29 September 2015 and by presiding over the Article XIV process over the coming two years. In their respective articles, Japan's Foreign Minister Fumio Kishida and Kazakhstan's Foreign Minister Erlan Idrissov explain why the nuclear test ban remains a top priority for their respective countries.

In Hiroshima this August, Members of the Group of Eminent Persons (GEM) gathered to discuss ways to advance the CTBT's entry into force. The group also met in Seoul, Republic of Korea, in June.

In this issue, GEM member and EU High Representative for Foreign Affairs and Security Policy Federica Mogherini reflects on the repercussions of the Iran nuclear agreement, while former UN High Representative for Disarmament Affairs Angela Kane, also a GEM member, describes ways to overcome today's "disarmament malaise".

In 2016, two decades will have passed since the adoption of the CTBT on 24 September 1996. With entry into force continuing to elude us, there is no cause for jubilation. Yet we do have reason to be proud of what the CTBTO, through the support of its Member States, achieved in terms of building a verification regime that surpassed all expectations. What is now needed is to work together to create the conditions for the Treaty's entry into force. It is through multilateral cooperation and coordination that progress in nuclear non-proliferation and arms control will be achieved.

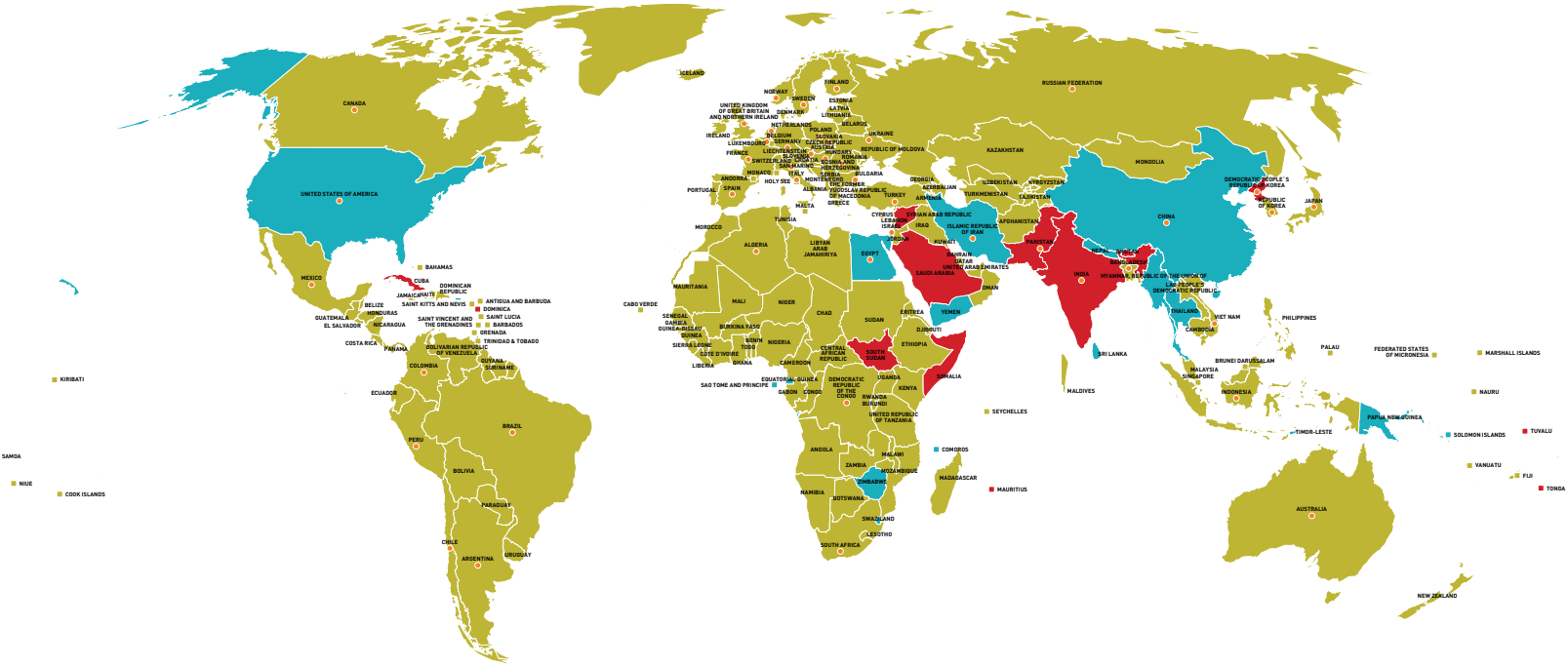
The CTBTO Member States' policy-making organ overseeing the build-up of the verification regime is Working Group B, short WGB. In this issue, one of the longest-serving WGB delegates, Robert Kemerait from the U.S. Air Force Technical Applications Center, looks back at the past two decades of WGB milestones.

Under the CTBT, on-site inspections are the ultimate verification measure, and drilling into a suspected nuclear explosion chamber is the ultimate on-site inspection measure. In their article, Walter Dekin from the Lawrence Livermore National Laboratory and Ward Hawkins from Los Alamos National Laboratory outline the requirements for conducting this most demanding and hazardous of all on-site inspection techniques.

We round off this issue with a sampling of artists' interpretations and inspirations around the topic of nuclear testing, which were on show this summer and autumn in China, Austria and in New York, proving that a picture really can say more than a thousand words.

[1] As of September 2015, eight remain: China, Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan, and the United States.

STATUS OF SIGNATURES AND RATIFICATIONS
AS OF 4 SEPTEMBER 2015



SIGNATORY STATES	RATIFYING STATES	NON-SIGNATORY STATES
183	164	13
41	36	3

● ANNEX 2 STATES: 44

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

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FACEBOOK

Group of Eminent Persons (GEM)

Meeting in Seoul, Republic of Korea, from 25-26 June 2015 with ROK Foreign Minister Yun Byung-se (centre).

To ensure an innovative and focused approach to advance the CTBT's ratification by the remaining Annex 2 States, a group comprising eminent personalities and internationally recognized experts was launched in September 2013 at the United Nations Headquarters in New York.

Through their expertise, experience and political standing, this Group of Eminent Persons (GEM) supports and complements efforts to promote the Treaty's entry into force as well as reinvigorating international endeavours to achieve this goal.

As Co-Presidents of the Article XIV process for the period 2015 to 2017, the Foreign Minister of Japan, Fumio Kishida, and the Foreign Minister of Kazakhstan, Erlan Idrissov, are ex-officio members of GEM.

Members of GEM last gathered in Seoul, Republic of Korea, from 25 to 26 June 2015 and in Hiroshima, Japan, from 24 to 25 August 2015, where they discussed different approaches and modes of action to assist the Executive Secretary in advancing the CTBT's entry into force, in addition to focused discussions on the eight Annex 2 States that have not yet ratified the Treaty.

Visit of the GEM to the Hiroshima Peace Memorial Museum, 25 August 2015.

Meeting in Hiroshima, Japan, 24-25 August 2015 with Kazuyuki Nakane, Parliamentary Vice-Minister for Foreign Affairs (front row, 4th from right).

Iran deal bodes well for CTBT's entry into force

BY FEDERICA MOGHERINI, EUROPEAN UNION HIGH REPRESENTATIVE FOR FOREIGN AFFAIRS AND SECURITY POLICY

The nuclear deal signed with Iran in Vienna, Austria, on 14 July 2015 for a comprehensive, long lasting and peaceful solution to the Iranian nuclear issue is first of all a great victory for the culture of non-proliferation. Some have likened it to the Comprehensive Nuclear-Test-Ban Treaty: as the Executive Secretary of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) Lassina Zerbo rightly pointed out, this is a "milestone that offers a new opportunity for progress on non-proliferation and disarmament issues."

At the same time, it is an unprecedented success for multilateral diplomacy. World powers – Europe, the United States, Russia and China, with UN backing – have come to realize that leaving the Iranian nuclear issue unsolved would represent a threat to all. Addressing the issue together could possibly open a brand new chapter in regional and global politics. New possibilities can arise in the future months and years – among them, relaunching the process towards the entry into force and the universalization of the Test-Ban Treaty.

The Treaty's entry into force remains a top priority for the European Union and for myself. I have the honour to be part of the Group of Eminent Persons who have supported and promoted the Treaty since the group's foundation in 2013. Signing the Comprehensive Joint Plan of Action with Minister Javad Zarif of Iran and our colleagues was not simply the culmination of months of intense negotiations; for me, it was an uplifting moment in what I see as a lifetime commitment to non-proliferation and disarmament.

The Vienna deal reinvigorates our will to keep on the same path. Now I believe that the entry into force of the CTBT is truly within reach. It is in the interest of the eight Annex 2 countries that still need to ratify the Treaty[1], and in the interest of their own people. There are some good reasons to be optimistic. Vienna shows that nothing is impossible if there is enough political will. The EU and I will keep using every opportunity to advocate for ratification, both with political leaders and with public opinion in these countries.

The EU's political efforts go hand in hand with its financial commitment to support the Test-Ban Treaty and its organization. Regular contributions from EU Member States to the CTBTO amount to roughly 40 per cent of its total annual budget. In addition, the EU has provided the Organization with more than 15.5 million euros in voluntary contributions since 2006, which places the EU amongst the most significant financial contributors to the CTBTO. We are currently working on an additional Council Decision to provide financial support to the CTBTO beyond 2015.

The nuclear tests conducted by the Democratic People's Republic of Korea in 2006, 2009 and 2013 have clearly demonstrated the relevance of the Treaty and showed that the performance of the Treaty's verification regime is truly improving. The operational readiness of the verification regime can help promote the Treaty's entry into force. The successful conduct of the Integrated Field Exercise in Jordan in November–December 2014 (a full-scale simulation of an on-site inspection) marks a turning point in this regard, and is a major step for further advancing operational readiness in the field of on-site inspections. I hope that this success will help us to promote the ratification of the Treaty, and will also contribute to raising confidence in the Middle East on how crucial the Treaty can be to peace and stability in the region.

The deal we reached in Vienna can open a new chapter towards a more cooperative order for the Middle East and beyond. Years of negotiations have come to an end. Our common work for non-proliferation is definitely not over. There is still much to do, but we can now move forward with even stronger resolve.

[1] China, the Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan, and the United States of America

BIOGRAPHICAL NOTE

FEDERICA MOGHERINI

has been the European Union's High Representative for Foreign Affairs and Security Policy since August 2014. Prior to that she served as Foreign Minister of Italy from February 2014, and before that as President of the Italian delegation to the NATO Parliamentary Assembly. In 2008 she was elected to the Italian parliament's Chamber of Deputies, where she served as Secretary of the Defence Committee and as a member of the Parliamentary Assembly of the Council of Europe. She was also a member of the Committees on Foreign Affairs and Defence in the Italian parliament.

Overcoming the disarmament malaise

BY ANGELA KANE, FORMER UNITED NATIONS HIGH REPRESENTATIVE FOR DISARMAMENT AFFAIRS

Seventy years ago, the explosions over Hiroshima and Nagasaki obliterated tens of thousands of lives in seconds. By contrast, the process of nuclear disarmament and non-proliferation – as I know only too well from serving as United Nations High Representative for Disarmament Affairs – moves more at the speed of continental drifts. The Conference on Disarmament in Geneva has not implemented a programme of work in nearly 20 years, ever since it debated the Comprehensive Nuclear-Test-Ban Treaty (CTBT), and the UN Disarmament Commission in New York has not agreed on anything since 1999.

The year 2015 presented formidable challenges in terms of nuclear disarmament: heightened tensions between Russia and the United States saw the deployment of new nuclear missiles, increased bomber flights from both sides, as well as large-scale nuclear modernization programmes. The Nuclear Non-Proliferation Treaty Review Conference in May ended without agreement on a final document. And, more recently, North Korea hinted that it might conduct another nuclear test in October to celebrate the anniversary of the founding of the Korean Workers' Party.

But in the midst of these dark clouds, let us focus on some bright spots. The agreement on a Comprehensive Plan of Action between the E3/EU +3 countries and Iran reached in July has shown that a commitment to persevere in multilateral diplomacy and the willingness to negotiate can lead to a mutually acceptable agreement. The inspections by the International Atomic Energy Agency will show whether it is also a durable one.

The issue of verification is clearly key to building trust in any nuclear arms control agreement. Through its International Monitoring System, the worldwide system of seismic, hydroacoustic, infrasound and radionuclide stations, the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) provides its Member States with the confidence that no nuclear test will go unnoticed.

The tremendous success of the CTBT in stopping nuclear testing – even before having entered into force – is due largely to this unique system. This year, the CTBTO installed its 300th station, bringing the system a step closer to its final configuration of 337 facilities.

However, this should not make us complacent. The fact that the CTBT remains in a legal limbo also has repercussions for its verification regime. Its most powerful verification element – namely on-site inspections – will become operational only once the remaining eight Annex 2 States have signed and ratified.

There should be no more delays in bringing the CTBT into full legal standing. I am convinced that a legally binding ban on nuclear tests will also bring us considerably closer to outlawing and eliminating nuclear arms altogether. Weapons that are illegal to test should also be illegal to possess.

Many States are frustrated with the lack of progress on the issue of nuclear disarmament and have voiced their demands through efforts aimed at finding new approaches to eliminate nuclear weapons. Most prominent among these is the humanitarian approach to nuclear disarmament, which underscores the devastating human impact of nuclear weapons and is also grounded in international humanitarian law. This approach is supported by a clear majority of UN Member States, as illustrated by the 158 countries – including two nuclear-weapon States, the United Kingdom and the United States – that attended the third Conference on the Humanitarian Impact of Nuclear Weapons, hosted by Austria last December.

The humanitarian approach has energized the debate around nuclear disarmament and has brought together not only government officials and NGOs, but a range of players not traditionally associated with disarmament, from human rights groups to environmentalists.

The broad participation of different parts of society makes me hopeful that the remaining eight States will move forward with ratification. With the notable exception of North Korea, nuclear testing is not an issue in any of these eight countries, let alone anywhere else in the world.

Still, achieving entry into force will be no easy feat. But to paraphrase the Roman emperor and philosopher Marcus Aurelius, who died in Austria in 180 C.E.: Just because something seems difficult to you, do not think it impossible to accomplish. That is the spirit in which we must continue to pursue an ambitious disarmament agenda.

BIOGRAPHICAL NOTE

ANGELA KANE

has served as UN High Representative for Disarmament Affairs since 2012. Previous UN posts included Under-Secretary-General for Management from 2008 to 2012 and Assistant Secretary-General for Political Affairs from 2005 to 2008. Prior to that, Kane served as Director in the Department of Political Affairs and the Department of Public Information. Her prior experience also includes the positions of Principal Officer for Political Affairs with the UN Secretary-General, Deputy Special Representative of the Secretary-General for the Mission in Ethiopia and Eritrea, and a special assignment to the Democratic Republic of the Congo.

Why Japan is fully committed to the CTBT

BY FUMIO KISHIDA,
MINISTER FOR FOREIGN AFFAIRS OF JAPAN

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is a crucial legal tool to realize a world free of nuclear weapons. The adoption of the draft text of the CTBT in 1996 was a sign of the international community's firm determination to ban nuclear testing, and articulated a vision for our future. With the most recent ratification by Angola in March this year, there are currently 183 State Signatories and 164 ratifying States.

The CTBT is underpinned by a robust verification system, the International Monitoring System (IMS), which has already proven its effectiveness on many occasions. Japan supports this system through 10 fully functioning monitoring stations within the country. Japanese scientists have actively been involved in technical aspects of developing the verification system, including their recent participation in the *CTBT: Science and Technology 2015 Conference* in Vienna in June this year, which helped to further refine the detection of clandestine nuclear tests. Furthermore, Japan has contributed to the development of this global network in the form of voluntary contributions as well as its unique technical training course (Global Seismological Observation Training), which Japan has now been offering for 20 years. To date, 196 experts from 80 countries have been trained and are expected to play key roles in further strengthening the IMS.

The IMS is also valued increasingly for its many spin-off benefits since the data generated by the stations can be used for disaster warning and scientific research. In Japan, where many communities on the Eastern coast are still recovering from the March 2011 tsunami, CTBTO data are used to enhance our early warning systems.

The CTBT has gone a long way in the de facto prohibition of nuclear testing. While the CTBTO is carrying out its mandate, however, only the CTBT's entry into force will create a legally binding international ban on all forms of nuclear explosions. Japan has therefore wholeheartedly embraced CTBTO Executive Secretary Zerbo's initiative to create the Group of Eminent Persons (GEM).

At the end of August, GEM members gathered in this historic year in Hiroshima, Japan; I was impressed by the energy and creativeness of the members in exploring new ways to convince the eight remaining Annex 2 States[1] to ratify the CTBT so that it can finally enter into force.

I hope that the same spirit will guide the *Article XIV Conference* in September 2015 to facilitate the CTBT's entry into force, which I will co-chair with Erlan Idrissov, Foreign Minister of Kazakhstan. Our two countries are natural allies in the fight against nuclear testing, and we are fully committed to leading international efforts to achieve the Treaty's entry into force during our chairmanship from 2015 to 2017.

BIOGRAPHICAL NOTE

FUMIO KISHIDA
has been Japan's Minister for Foreign Affairs since 2012. Prior to this, he served as Chairman of the Liberal Democratic Party's Diet Affairs Committee from 2011. From 2008 to 2011, he was Minister for Consumer Affairs and Minister for Space Policy. Previously, he served as Minister of State for Okinawa and Northern Territories Affairs, Quality-of-Life Policy, Science and Technology Policy, and Regulatory Reform, a position he held from 2007. In 2005, he was appointed Chairman of the Committee on Health, Labour and Welfare of the House of Representatives.

[1] The Annex 2 States are 44 countries that must ratify the CTBT before it can enter into force. They all participated in the negotiation of the CTBT from 1994-1996 and possessed nuclear power or research reactors at the time. Eight Annex 2 States still have to ratify: China, Democratic People's Republic of Korea, Egypt, India, Iran, Israel, Pakistan and the United States of America.

Time to ban nuclear weapons testing forever

BY ERLAN IDRISSOV,
MINISTER FOR FOREIGN
AFFAIRS OF KAZAKHSTAN

The story of Kazakhstan's independence is intricately linked to the banning of nuclear testing and the renunciation of nuclear weapons. On 29 August 1991, Kazakhstan became the first country in the world to close a nuclear test site on its territory. The decision by President Nursultan Nazarbayev to close the Semipalatinsk nuclear test site where the Soviet Union carried out more than 450 nuclear weapon tests was welcomed by the people of Kazakhstan, and helped lead to the country's declaration of independence on 16 December 1991.

It is no surprise that the Kazakh people were so strongly supportive of the decision to shut the Semipalatinsk site. The tests, which took place between 1949 and 1989, had the combined explosive power of 2,500 atomic bombs dropped on Hiroshima. The fall-out from these tests – of which over 100 were above ground – affected 1.5 million people and led to radioactive pollution to various degrees of an area roughly the size of today's Germany.

It has left a terrible legacy. A generation later, deaths, deformities and cancer from radiation remain all too common in this region. My home town Karkaralinsk, some 400 kilometres west of the test site, has not been spared. For us and many other communities, the threat from nuclear weapons is not abstract but all too real.

OUR CLEAR CHOICE

When the Soviet Union collapsed in 1991, Kazakhstan inherited the fourth-largest nuclear arsenal in the world: more than 100 ballistic missiles and more than 1,000 nuclear warheads, capable of reaching any point on Earth. What is less well known is that we also found ourselves, if it had been our wish, with the infrastructure and expertise to maintain and deploy this arsenal.

This was not the choice that Kazakhstan made. Instead, my country opted for full nuclear disarmament and active participation in all non-proliferation treaties and regimes. This decision may seem surprising, given Kazakhstan's unique geopolitical position between two major nuclear powers. But those familiar with my young country, its people and leadership understand that Kazakhstan believed the retention of nuclear weapons would damage, rather than bring, security and prestige.

Since its independence, Kazakhstan has been vigorously promoting the principles and ideals of nuclear disarmament and working tirelessly to rid the world of the nuclear threat. We are a founding member of the 2009 Nuclear-Weapon-Free Zone in Central Asia, which outlaws nuclear weapons and their testing in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

Through our recently signed agreement with the International Atomic Energy Agency to host its Low Enriched Uranium Bank, we will establish a guaranteed stock of nuclear fuel to ensure that there is no disruption to countries' supplies and to help them develop civilian nuclear power while meeting all non-proliferation requirements.

Kazakhstan has also played an active role in the Nuclear Security Summits in Washington, D.C. (2010), Seoul (2012) and The Hague (2014), which aim to strengthen the international framework to prevent nuclear materials from falling into the hands of terrorists.

A KEY DATE: 29 AUGUST

Our clear immediate priority in the field of nuclear disarmament and non-proliferation, however, is the nuclear test ban. In 2009, at the initiative of Kazakhstan, the United Nations General Assembly adopted a resolution proclaiming 29 August as the International Day against Nuclear Tests. The date has a deep symbolic significance as it is not only the day on which the Semipalatinsk site was closed but it also marks the anniversary of the Soviet Union's first nuclear weapons test in 1949.

Since its first commemoration in 2010, the International Day against Nuclear Tests has helped raise public awareness about the terrible consequences of nuclear testing and the need to ban them once and for all through the entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). It is also an annual reminder of the importance of maintaining international efforts to continue nuclear disarmament. The ultimate goal must be to rid the world of its Cold War legacy of nuclear weapons and the outdated psychology of nuclear deterrence that underpins their continuing existence. This is a goal that has no doubt become even more critical in view of the current trends in international relations.

At this year's events to mark the International Day against Nuclear Tests in Astana, Kazakhstan, we took stock of the 24 years that have passed since the closure of the Semipalatinsk test site. We noted with great satisfaction that the intervening years have proved that we made the right decision. As we hoped, Kazakhstan continues to enjoy peaceful relations with all of its neighbours. Instead of squandering our resources on maintaining and/or developing weapons of mass destruction, we have been able to invest in roads, hospitals and universities.

» Those who know my country and its people understand that Kazakhstan sees neither security nor prestige in nuclear weapons.«

The closure of the Semipalatinsk nuclear test site was followed by the shutting down of other major test sites in Nevada (USA), Novaya Zemlya (Russia) and elsewhere. These closures together paved the way for the negotiation of the CTBT in the mid-1990s.

SHARED DETERMINATION

This year's International Day against Nuclear Tests was particularly poignant because August also saw the 70th commemoration of the bombings of Hiroshima and Nagasaki. Our two countries' experiences explain why Japan and Kazakhstan share the same determination to strive for a nuclear-weapon-free world. This is why it is also natural that our nations will jointly chair this year's CTBT Article XIV Conference, the biennial mechanism for facilitating the Treaty's entry into force. Together with Foreign Minister Fumio Kishida, who himself is from Hiroshima, we will spare no effort to spearhead international efforts to advance the CTBT's entry into force during our two-year chairmanship.

In addition to President Nazarbayev's efforts to end nuclear testing by engaging at the highest political level with the eight countries that have yet to sign and/or ratify the CTBT, in 2012 the President launched a global education and online petition campaign, the ATOM Project which stands for "Abolish Testing: Our Mission." So far, more than 200,000 people from around the world have added their names to calls on world leaders to formally and permanently renounce nuclear testing.

READY FOR VERIFICATION

The ban on nuclear tests is underpinned by an impressive verification system, which is already largely operational even before the Treaty has entered into force. Kazakhstan contributes to this system through five monitoring stations. Data are transmitted directly to the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna and to the Kazakhstan National Data Centre, which also uses the information for the purposes of disaster warning and scientific research.

In addition to a series of CTBTO field tests and training events, Kazakhstan hosted the organization's first full-scale on-site inspection simulation, the Integrated Field Exercise (IFE08), at the former Semipalatinsk nuclear test site in 2008. Building on this experience, the CTBTO carried out its second Integrated Field Exercise in Jordan in 2014. This simulation, in which experts from Kazakhstan participated, demonstrated convincingly that the CTBTO has now mastered all components of the Treaty's verification regime.

The CTBTO has clearly delivered. Now the ball is in the court of the eight remaining countries. We hope that Kazakhstan's history and example will inspire these nations not only to embrace the CTBT, but also to turn their backs on these terrible weapons and make our world and future safer.

BIOGRAPHICAL NOTE

ERLAN IDRISSOV
was appointed Minister of Foreign Affairs of Kazakhstan in 2012, a position he also held from 1999 to 2002. Idrissov began his diplomatic career in 1985. Previously he served as First Secretary of the Permanent Mission of Kazakhstan to the UN, Head of the Americas Department at the Ministry of Foreign Affairs, Ambassador-at-large, Adviser to the President of Kazakhstan, and First Deputy Minister of Foreign Affairs. Idrissov was also Ambassador to the UK, Sweden, Norway, Ireland, and the United States.

VOICES

Two succesful decades of Working Group B

BY ROBERT KEMERAIT
SENIOR SCIENTIST,
AIR FORCE TECHNICAL
APPLICATIONS CENTER (AFTAC)

In August 2015, technical experts representing the 183 Member States of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) congregated in Vienna, Austria, to discuss issues related to the verification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). It was the 45th meeting of what is commonly known as Working Group B (WGB). I take great pride in WGB's achievements and am fortunate to be one of a few experts to have participated in every single meeting since the group's inception in 1997.

The number of WGB meetings to date has further significance. Before the CTBT opened for signature in September 1996, another group which was known as the Group of Scientific Experts (GSE) met 45 times over a 20-year period to develop and test several concepts required to help verify a potential comprehensive test ban treaty. It therefore seems appropriate to look back to the beginning and to consider where we are today and what we can hope for the future.

THE BEGINNINGS: 1976-1996

To appreciate the evolution of our critical mission from its early days to the initiative that has now become the CTBTO, we must look back to the efforts of the GSE, established by the United Nations Conference on Disarmament held in Geneva, Switzerland. The GSE was tasked to provide through international cooperation research and development for detection, monitoring and analysis procedures needed for nuclear testing verification.

To accomplish that goal the GSE designed a process through which experimental seismic data were collected and sent to an experimental International Seismic Monitoring System with an innovative International Data Centre in Arlington, Virginia, USA. It was in that facility, which I visited often during that time, that the first software for processing global seismic and hydroacoustic monitoring data was created. Little did I know that in future years my career would be intimately linked with that software and the goals of this programme.

Those who were involved with the GSE know that their efforts provided the background for the current CTBT: the techniques involved, the data used in the analysis process, the design for the International Data Centre (IDC), the International Monitoring System (IMS), and data authentication.

THE EARLY YEARS

When the GSE programme moved from Geneva, transitioning into the CTBTO, the first WGB meeting was held at the Vienna International Centre in Austria in 1997; this was my introduction to a programme and a goal that would define the following years of my career. It was then that I met outstanding international scientists who had originally served the GSE and now brought an understanding and a history of the technology and

Certification visit to PS48 in November 2001.

the programme to the newly formed CTBTO. There was, and still is, a special honour for them in having "been there from the beginning"!

The Preparatory Commission was created as an oversight group within the new CTBTO structure; I was sent by the U.S. State Department to several early meetings. Many of the members of this Commission had been involved in the GSE.

In those early days there were many behind-the-scenes tasks to be completed to prepare systems and programmes for future Treaty verification. Looking back at the WGB's early schedule of work, the focus was on the development of the IMS and the IDC, communications, evaluation, confidence building measures, on-site inspections (OSI), authentication, and operation manuals. Many of these topics had been first introduced through earlier GSE work.

In those early meetings parallel sessions were provided; experts from the IMS and the OSI divisions met in concurrent sessions. Because of the heavy workload of these years, three WGB meetings were scheduled each year: in February, May, and August.

To illustrate some of the behind-the-scenes work necessary to create this new, unprecedented and massive worldwide project, I served on a number of committees tasked to move us to Mission Readiness, among them the IMS Development Plan under Chairman John Alwyn Davies. This 1997 committee was tasked to create an important plan of work for the next year: to build the IMS.

Ken Muirhead chaired the task on the inventory of stations to make up the IMS: We were charged with evaluating the status of stations in specific Member States. Beginning with the list of stations required by the CTBT in a specific country, we had to determine if a reported station even existed. And many times it did not. If a station did exist, did it meet IMS requirements? If it did exist, but didn't meet IMS requirements, what would be required to bring it up to standard?

The site surveys task, also chaired by Ken Muirhead, involved determining the requirements necessary to complete a site survey in order to build a station, if no station was in place. Local conditions had to be considered; for example, some sites were located in places exposed to frigid temperatures or in extremely remote areas. I also served under Muirhead on the model agreements committee, working to ensure that the agreement a Member State signed was appropriate for that nation's unique situation.

The authentication requirements committee, under Chairman Yves Caristan, worked toward satisfying CTBT requirements for a system to authenticate data so that the data could not be modified to appear genuine when it was not!

In the station specifications task, also under Yves Caristan, we

Certification visit to PS48 in November 2001.

Robert Kemerait at a Working Group B meeting (45th Session), Vienna, Austria, September 2015.

evaluated the GSE specifications and then modified them to meet the requirements set for the CTBT system. Additional research and technology had been developed, meaning that the revised requirements were probably more stringent.

Under Chairman Mohsen Ghafory-Ashtiani, the IMS training programme committee planned and directed training to be held in Vienna for the many countries that had signed the CTBT but had no experience with stations, with handling and processing the developing data, or with maintenance of the stations' equipment.

Members of the operational manuals committee, under Chairperson Victoria Oancea, worked carefully to phrase requirements for the IMS stations and instructions for their operation.

Each of those committees, and many others, contributed to the massive effort directed toward mission readiness, but only the operational manuals committee exists today; the tasks of the other committees have been completed.

CURRENT STATUS

The middle years saw major changes. The WGB agenda changed, now covering a broader range of topics. Parallel sessions, the third yearly meeting, and sessions related to the IDC and IMS were eliminated. Waveform and radionuclide expert group discussions were added.

Now that most of the IMS network is installed and operating, the IDC Division has recently gone to Phase 5b operations with relatively new personnel, and the OSI Division has successfully completed the Integrated Field Exercise 2014 (IFE14) in Jordan by incorporating personnel from the IMS and IDC divisions. One could not have scripted this better.

Throughout these years, good capable leadership, support staff, and delegates have served. When they have left, good, capable people have arrived, well prepared to fit the changing situations.

With preparations nearing completion for a worldwide ban on nuclear weapons testing we are still lacking the Treaty's entry into force. However, the eight outstanding ratifications that are preventing the CTBT from becoming international law are unrelated to CTBTO personnel or operations. On the contrary, the very existence of the CTBT has been causal, in my opinion, to having almost eliminated nuclear testing around the world.

LOOKING AHEAD

Our ultimate goal for the later years of the CTBTO and WGB would be full ratification of the Treaty and a worldwide ban on the testing of nuclear weapons to bring greater security to our planet. Those of us who have contributed toward this great humanitarian goal should feel a special pride in our contributions toward the well-being of all mankind and of our shared home, Planet Earth.

BIOGRAPHICAL NOTE

ROBERT KEMERAIT
has been a senior scientist at the Air Force Technical Applications Center (AFTAC) since 2005, where he has been working since 1974. He has been supporting the CTBTO as a delegate of WGB since its first session in Vienna in 1997. Kemerait served in the U.S. Army before studying electrical engineering at the University of Florida. Prior to his job at AFTAC, Kemerait also worked at NASA's Kennedy Space Center and taught electrical engineering at the Florida Institute of Technology in Melbourne.

SnT 2015 IN PICTURES

The CTBT: Science and Technology 2015 Conference (SnT2015) took place from 22 to 26 June 2015 at the Hofburg Palace in Vienna, Austria. It was the fifth in a series of multidisciplinary conferences designed to further enhance the strong relationship between the scientific and technological community and the CTBTO. The conference series provides a forum for scientists from around the world to exchange knowledge and share advances in monitoring and verification technologies of relevance to the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Such interaction helps ensure that the Treaty's global verification regime remains at the forefront of scientific and technical innovation. With nearly 1110 registered participants and over 550 abstracts, SnT2015 was the largest such conference to date.

»It gives me hope for the future of our children that the best and brightest scientists of our time congregate to perfect the detection of the bomb instead of working to perfect the bomb itself.«

CTBTO Executive Secretary Lassina Zerbo

Members of the Technology for Global Security (Tech4GS) group joined former U.S. Secretary of Defense William Perry in a panel discussion on 'Citizen Networks: the Promise of Technological Innovation' (above) which discussed the opportunities that new and emerging technologies can play in overcoming the challenges of nuclear weapons and nuclear security.

Other prominent speakers included Lord Browne of Ladyton (Des Browne), Vice Chairman of the Nuclear Threat Initiative and a former UK Defence Minister, member of the CTBT Group of Eminent Persons (above right); Ahmet Üzümcü, Director-General of the Organisation for the Prohibition of Chemical Weapons (below left), and Frank G. Klotz, U.S. Department of Energy's Under Secretary for Nuclear Security and Administrator for the National Nuclear Security Administration (below right).

Another keynote speaker was Naledi Pandor, South Africa's Minister of Science and Technology (top left), here trying the georadar with CTBTO Executive Secretary Lassina Zerbo. This and other on-site inspection equipment were on display at the Hofburg Palace (above centre and above right). Other interactive features included "Listen to our Earth", where participants could hear and see different kinds of signals recorded by the International Monitoring System (below). The conference also featured a Young Scientists' Evening and research grants – funded by the European Union – awarded to young scientists for CTBT-related studies (right, 3rd from above). At the CTBT Academic Forum (left centre), participants shared their experiences in promoting CTBT education and training the next generation of CTBT experts in their home institutions.

Everything is connected

BY ARI M. BESER, AUTHOR AND JOURNALIST

"Everything is connected," exclaimed Takeshi Miyata as he walked along the railway at the Auschwitz death camps, almost 70 years after Jews were carted off to slaughter in the same location. "Jewish scientists escaped the Nazis, helped America build an atomic bomb, and it was dropped on me."

Anyone who entered Hiroshima and Nagasaki within two weeks of the release of the only two atom bombs ever detonated over people were called Hibakusha: "Exposed to the atomic bomb/radiation." Miyata, and eight other members of the Peace Boat Hibakusha Project, had travelled halfway around the world from Japan. They shared their cautionary tales of nuclear power in each port of call along the way. Some spoke publicly for the first time in their lives. I was their web reporter.

'Peace Boat', part cruise ship, part political lobby, was on its 80th voyage in 30 years. The Hibakusha Project was participating in a Peace Boat voyage for the sixth time. Our journey in 2013 started in Da Nang, Vietnam, where we spent the day with victims of Agent Orange who had experienced generational effects of the chemical's wartime use. We confronted Japan's own violent past in Singapore at the National History Museum. We shared a testimony with a Hungarian-Polish Auschwitz survivor at the Centre for Dialogue in Poland, and befriended El Salvadorian revolutionaries in Central America.

Over 85 days we spoke at city halls, foreign ministries, schools, and temples in more than 19 countries. Thousands of people will now forever be able to say they met someone who survived the bombings of Hiroshima or Nagasaki, and heard their testimony.

SADAKO'S SAD FATE

Passengers on the ship called us the Orizuru Project. In Japanese "Orizuru" means "Paper Crane." They say in Japan, that if you fold one thousand paper cranes, a wish will be granted. In 1955 Sadako Sasaki tried everything, including the "Paper Crane" legend, to cure her leukemia 10 years after she was exposed to the atomic bomb in Hiroshima. She wasn't the only one. Every family that survived Hiroshima had a Sadako, an unknown victim who was not made famous for their grace under pressure. A monument to memorialize all of the child victims was erected by Sadako's classmates and years later her story was told around the world. This is how I learned about it in school when I was her age.

> »They say in Japan that if you fold one thousand paper cranes, a wish will be granted.«

Miyata-san wasn't the only one who could see connections. I wasn't just a web reporter documenting Peace Boat's Hibakusha Project. My grandfather was Jacob Beser, the only man in the world to fly as a serviceman on both planes

that dropped the atomic bombs on Hiroshima and Nagasaki. He was the radar countermeasures officer. In essence he helped build and monitor the radar-detonated fuse for the so-called "gimmick."

Many people know that my grandfather was on the airplanes but few know that my family also has a connection to someone who was underneath the mushroom cloud.

BOTH SIDES OF THE BOMB

I wrote about this coincidental connection in 2010 and mentioned Maiden J. publicly (and I will not use her name again). Her surviving family is very protective of her legacy, having been "burned" by Japanese media in the past who wanted to dramatize her love story. Her family was upset that I started to write about her, until they realized they knew me.

She left Hiroshima in the late 1960s to marry an American who courted her while she lived in New York where she received reconstructive surgery with the famous Hiroshima Maidens. She eventually settled in Baltimore where she worked alongside my future grandfather Aaron Cohen. I met her when I was a child and was awestruck at knowing people from both sides of the bomb.

On 10 March 2011, I won a research grant to write a book about my family connections. It was already 11 March in Japan, a night when disaster struck. As the news unfolded of what would become known as the Great East Japan Earthquake, Tsunami and Nuclear Disaster, I decided not to give up my trip to Japan.

> » My grandfather was the only man in the world to fly on both planes that dropped the atomic bombs on Hiroshima and Nagasaki.«

THE NUCLEAR FAMILY

Five months later, I began the research for a book that took me five years to complete. *The Nuclear Family* has just been published. When I met Maiden J.'s family, they said, "We can be your friends but if you want to understand what happened, you must meet Hibakusha who will tell you first hand."

In Japan, I was introduced to Yuji Sasaki, the nephew of Sadako. A one-time Ramen (noodle soup) shop owner, he now dedicates his energy to "Sadako Legacy," his family's non-profit organization. When I met him for the first time, he was serving up delicious bowls of hot Hakata Ramen.

The Genbaku Dome, Hiroshima's former Prefectural Industrial Promotion Hall, was the only building left standing near the bomb's hypocentre. It is today a UNESCO World Heritage Site. Photo courtesy of Ari Beser.

The Nagasaki Peace Ceremony on 9 August 2015 was attended by CTBTO Executive Secretary Lassina Zerbo. Picture courtesy of Ari Beser.

Within minutes of our group's arrival, Yuji leapt to the back of his shop to look for a small plastic box. He returned momentarily and opened it to reveal a pin-size paper crane and a small folded triangle of paper. He placed the tiny crane in the palm of my hand and said, "This is the last crane she ever folded, and this triangle is the crane she didn't finish."

Yuji is changing the world with his aunt's paper cranes. He and his father Masahiro have donated Sadako's cranes to the Hiroshima Peace Memorial, the 9/11 memorial, and the Arizona Memorial at Pearl Harbor. There, Masahiro met a Pearl Harbor survivor who proclaimed, "They said you can't teach an old dog new tricks," before the Japanese and American survivors embraced in a hug.

Throughout the Fulbright–National Geographic Digital Storytelling Fellowship, I will explore the connections I have discovered over the last few years, and introduce these members of "The Nuclear Family" from the span of the 70th anniversary of the atomic bombings of Hiroshima and Nagasaki through the 5th anniversary of the Great East Japan Earthquake, Tsunami, and Nuclear Disaster in Fukushima. I will periodically update *Hibakusha: The Nuclear Family* with video installments, photo essays, and articles.

Paper lanterns are released onto the Motoyasu river, Hiroshima to commemorate the atomic bomb victims. Photo courtesy of Ari Beser.

This article has been adapted from the original post that appeared on the Fulbright National Geographic digital stories blog and appears with kind permission: voices.nationalgeographic.com/2015/07/20/the-story-about-hiroshima-and-nagasaki-youve-never-heard/

BIOGRAPHICAL NOTE

ARI M. BESER
is a Fullbright–National Geographic Fellow. He is the grandson of Lt. Jacob Beser, the only U.S. Serviceman aboard both B-29s that dropped atomic bombs over Hiroshima and Nagasaki. He has spent the past four years researching and authoring the book *The Nuclear Family* about both the American and Japanese perspectives of the atomic bombings. He has worked with Japanese and Americans to forward a message of reconciliation and nuclear disarmament.
Follow Ari on Instagram and Twitter @HibakushaTNF and @aribeser.

STATUS OF CERTIFIED IMS FACILITIES
AS OF 4 SEPTEMBER 2015

CERTIFIED	INSTALLED	UNDER CONSTRUCTION	PLANNED	TOTAL
281	20	18	18	337

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

MORE GOOGLE MAP FEATURES

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

PDF MAP CREATOR

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

PDF REPORTS

which provide a comprehensive breakdown of the map that was selected.

VISIT ONLINE:
ctbto.org/map

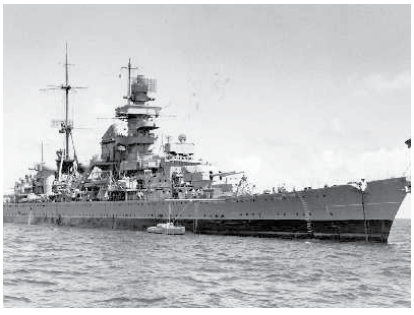
Identifying ships in photos of the Baker nuclear test

BY MICHAEL BÜKER, PHYSICIST AND SCIENCE COMMUNICATOR

The "Baker" explosion, part of Operation Crossroads, a nuclear weapon test by the United States military at Bikini Atoll, Micronesia, on 25 July 1946. Source: Wikimedia Commons.

This photograph above is probably one of the best known and most impressive when it comes to illustrating the scale and impact of a nuclear test – even if the explosion was a small one even by the standards of the 1960s. It shows the fifth-ever explosion of a nuclear bomb, about two years after the first-ever nuclear explosion in the Trinity test and one year after the attacks on Hiroshima and Nagasaki.

Military ships were placed in the vicinity of the two explosions of the test series in order to observe the effects of a nuclear explosion at close range. Most of the ships were in derelict state, dating back to the Second World War, which had ended only a year earlier. Among the most notable were the Japanese battleship *Nagato*, the German cruiser *Prinz Eugen* and the U.S. aircraft carrier *Saratoga*. After the two test explosions, all three – and several more ships – eventually sank and were abandoned for being too radioactive to salvage.



The German cruiser Prinz Eugen (1946).

A part of one of those ships, salvaged over 30 years after the nuclear tests, has been on display in northern Germany close to where I live, since 1979. It is one of the three propellers of the *Prinz Eugen*. After first reading about it, I came back to the topic every now and again, mostly because I was incredulous that this was a part that had actually been in the vicinity of the Crossroads nuclear explosions.

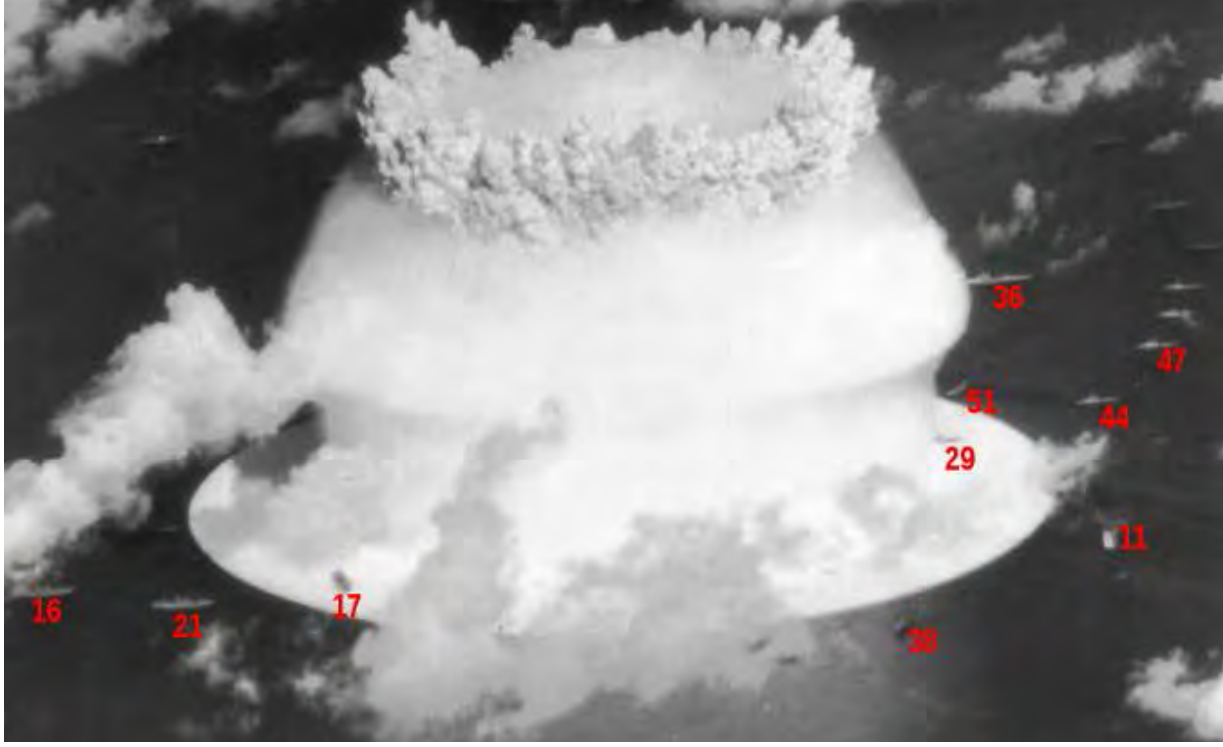
Given that it really does seem to be genuine, and neither a reproduction nor a part replaced before 1946, I went to visit the Laboe Naval Memorial in Germany. It is a curious memorial with an ambiguous character that is well reflective of the site's history, conceived some 10 years after the First World War, inaugurated by the Nazis and later rededicated to peaceful seas and the victims of all seafaring countries. In my opinion, however, the Memorial does not do a very convincing job of renouncing the glorification and romanticization of murderous naval warfare and truly exhibiting an international and intercultural spirit.

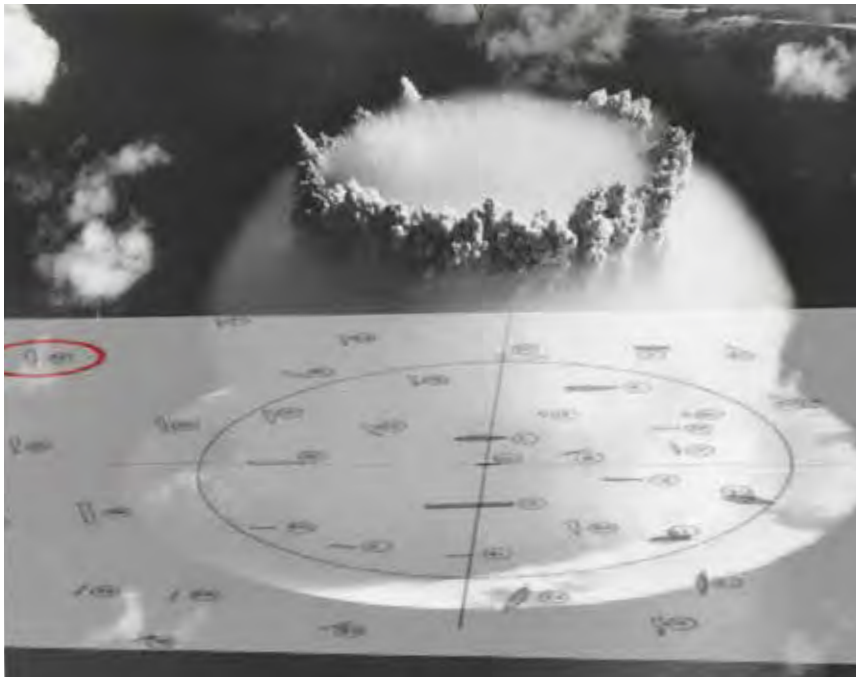
After seeing the propeller, I wanted to pick out the *Prinz Eugen* in photographs of the Crossroads nuclear tests. There did not seem to be, however, any annotated photographs detailing the identities of more than one or two ships in the vicinity of the explosion. After some research, I came across an online edition of *The Archeology of the*

Prinz Eugen's propeller at Laboe Naval Memorial, Germany. Picture: Darkone on Wikimedia Commons, CC-BY-SA 2.5.

Target vessels:

36 IX Prinz Eugen
47 DD Wllson
51 YOG-83
44 DD Trippe
29 DD Mayrant
11 ARDC-13
38 CA Salt Lake City
17 APA Briscoe
21 APA Catron
16 APA Bracken





View from the South, the Prinz Eugen is marked in red.

Atomic Bomb: A Submerged Cultural Resources Assessment of the Sunken Fleet of Operation Crossroads at Bikini and Kwajalein Atoll Lagoons, published and hosted by the U.S. National Park Service. Chapter Two by James P. Delgado features the layout of the sites of both tests conducted during Operation Crossroads, and gives the names of many of the ships involved. The famous view from the island towards the explosion, however, was photographed at an angle that makes it difficult to assess the relative positions of the ships and cross-reference them with the map. A perspective from above is much better suited for this, and there are high-quality photographs of the moment of the Baker explosion from different angles.

I referenced the map for the Baker test with aerial photographs of the explosion. I used the Perspective Tool of GIMP, a photo editing software, to overlay photographs from two different angles with appropriately distorted versions of the map. I cross-referenced the positions of the ships in both photographs, cloud shapes, the incident angle of the sun and the lighting/shades of the ships to make what I believe is a good match between the map and both photographs. The annotated pictures and lists depicted here give the names of those ships I have identified in the map-overlayed photographs with reasonable certainty.

This article has been adapted from the original post that appeared on Michael Büker's blog: gebloggendings.wordpress.com.

BIOGRAPHICAL NOTE

MICHAEL BÜKER
studied Physics in Hamburg and specialized in nuclear weapons and nuclear arms control at the Carl Friedrich von Weizsäcker-Centre for Science and Peace Research. He works as a science communicator and science journalist, explaining physics-related topics to the public through talks and the media. His topics include nuclear weapons and nuclear testing.

INTERVIEW

WITH ALEX WELLERSTEIN, HISTORIAN OF SCIENCE, STEVENS INSTITUTE OF TECHNOLOGY, CREATOR OF NUKEMAP

The 2D version of the NUKEMAP can be accessed at Alex Wellerstein's blog at http://nuclearsecrecy.com/nukemap/

What is the NUKEMAP?

The NUKEMAP is an online "mash-up" between Google Maps and nuclear weapon detonation effects codes that the U.S. government produced during the Cold War. It is a web-based tool that allows both the layman and the expert to model the physical consequences of a nuclear weapon anywhere in the world, showing not only the familiar zones of blast, heat and ionizing radiation, but it can also give rough estimates as to casualties, radioactive fallout and human impacts (the destruction of hospitals, schools and infrastructure). It is designed so that even someone who knows very little about nuclear weapons can quickly model several real-life nuclear weapons on locations they know well, and there are many advanced options that experts can use should they desire more fine-grained details. There is also a NUKEMAP3D that allows the user to create 3D, volumetric mushroom clouds in Google Earth, scaled appropriately to the size of the weapon selected.

What gave you the idea, and what was your intention?

As a teacher, I had always struggled to give a sense of the "scale" of nuclear weapons. They are so far removed from our everyday human experience that students quite understandably could either under- or over-estimate their power. Since 1945, a traditional visual means of doing this has been to make maps that allow you to see the damage in geographical terms. I wanted to do this in a dynamic, flexible way that could be used for any city in the world (as opposed to the "traditional" virtual targets of New York and Washington). Over time I also wanted to expand the flexibility to ask more expert questions of the model, and to find even more effective ways to convey their human effects, like modelling casualties. The NUKEMAP was not an explicitly political creation, except in as much as nuclear weapons have some inherently political implications. The goal is to educate, to get people on the same page as far as awareness of the weapons and their effects is concerned, so that they can have informed opinions about them both historically and in the present day. Rational people can disagree on the interpretation of the effects, but a rational discussion is only possible in the first place if the effects are understood. I have been very pleased that the NUKEMAP has been used across the political spectrum to support various positions — it is not seen as tainted by politics or bias, despite the polarizing nature of nuclear weapons.

How has it been received?

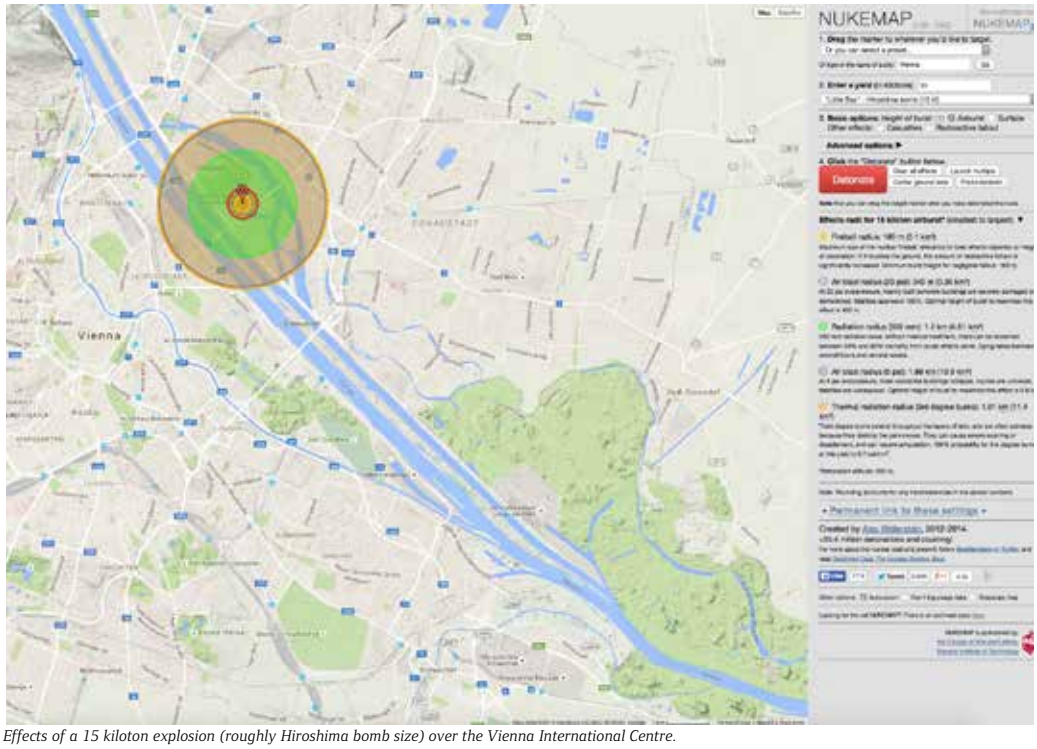
The NUKEMAP became much more popular than I ever could have expected. As of this summer it has been used by over 10 million people around the globe, setting off more than 50 million virtual "detonations." It has been used by journalists, by government agencies, and by educators to help communicate the effects of nuclear weapons. I have been most excited when it gets used for purposes well beyond what I could have anticipated, for example to discuss the historical implications of specific weapons, or to talk about the potential consequences of future events. I have also been very happy that it has been well-received by the expert "wonk" crowd of nuclear weapons policy analysts. Although they are not necessarily my primary audience, I felt that having their

endorsement and approval was necessary if it were to be a serious tool and not just an online distraction.

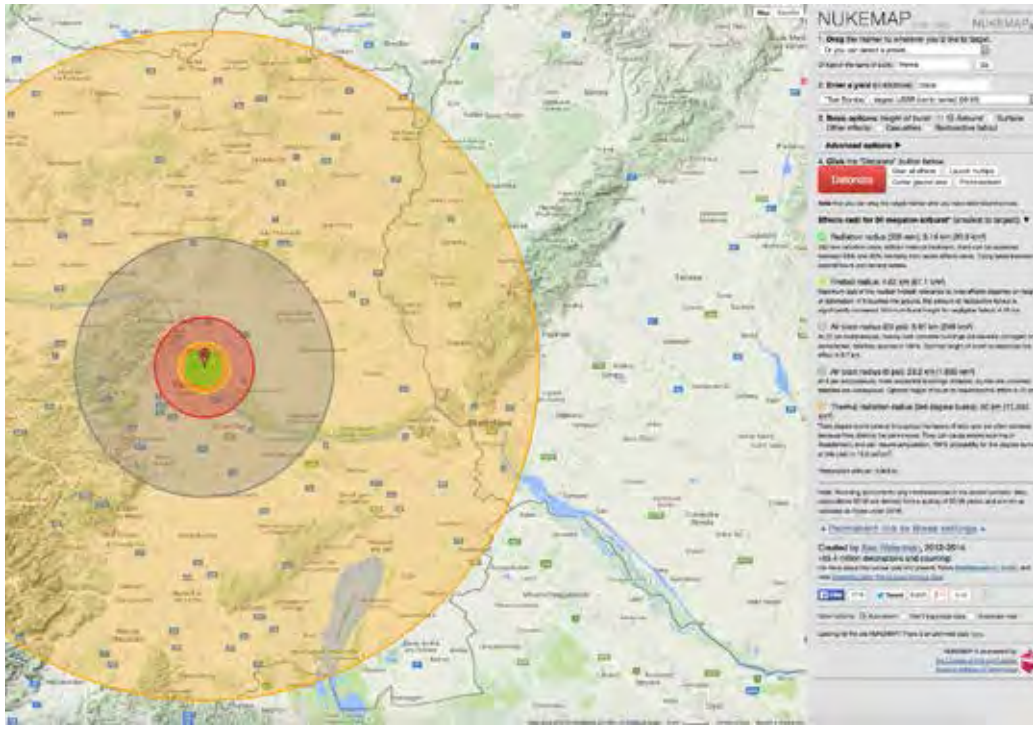
Do you see a special relevance of the NUKEMAP for the CTBT and for the U.S. administration's efforts at educating the public about the Treaty?

The future success of the CTBT rests on its signature and ratification by several key States, one of them being the United States. In my experience, even very highly educated Americans who do not have specific, personal interests in nuclear matters do not know about the CTBT or the fact that the United States signed but has not ratified it. Most people do not know that the Treaty exists, or do not know that it was signed, or do not know that ratification is required. Just a few days ago, I had a conversation with a weapons scientist from Los Alamos who mistakenly thought the CTBT was actually in legal effect because the attitude at the laboratory was that full nuclear testing will never occur in this country. There is no realistic possibility that the U.S. Senate will act upon a treaty of this sort if there is no public knowledge of it, and even less public opinion in favour of it. I do not presume the NUKEMAP will be a major force in this discussion. However, numerous people, especially "millennials," have told me that they had never thought much about nuclear weapons until encountering the NUKEMAP. In my most optimistic moments, I would like to believe that the NUKEMAP is, along with other media and world events, preparing the grounds for a new form of improved "nuclear literacy" among younger people, making up for the loss of awareness that happened in the immediate post-Cold War era.

I think that the NUKEMAP is not just a single-use tool, but a template for future tools that would aim to explain complex matters of science, technology and policy to the general public. There are many lessons to take out of it. For instance in terms of allowing "active learning" through experimentation and of attempting to present technical evidence in human terms without heavy political or ideological overtones. Even though people may interpret the evidence in different ways than one might want, one trust it is better for them to be on more solid technical footing than the contrary. I am currently working on expanding this approach to online visualization into other areas, both nuclear and otherwise. I hope that others will do so as well, both because the potential for education is so large, and because the relative return on investment (in terms of both time, labour, and real monetary cost) is extremely high when compared to other, more traditional forms



Effects of a 15 kiloton explosion (roughly Hiroshima bomb size) over the Vienna International Centre.



Effects of a 50 megaton explosion (the size of the largest nuclear test ever conducted – the Soviet 'Tsar Bomba' in 1961) over the Vienna International Centre.

of media, such as documentary films, books, and pamphlets.

What are the next steps in the NUKEMAP's evolution?

I have a long list of improvements that might be made in the future, pending time and resources. These include the ability to model more complicated, multi-detonation scenarios, as well as other effects such as electromagnetic pulse, sub-surface (e.g. "bunker busting") detonations, and fallout models that take a more sophisticated approach towards wind and weather. I would love to be able to take into account topography and building types. The key technical limitations are that I want anything I do to work on a global scale (e.g. not just a few cities or a single country), and it has to be possible to render it rapidly in a web browser. It would also be nice if there were good translations available for whatever language the user desired. A far-off goal is to develop other applications around the core NUKEMAP code that would allow one to simulate historical nuclear attack situations (such as the Cuban Missile Crisis) or future potential conflict situations (such as a war between Pakistan and India) and see the potential consequences.

Effects of a 15 kiloton explosion (roughly the size of the Hiroshima bomb) over the Vienna International Centre.

Effects of a 50 megaton explosion (the size of the largest nuclear test ever conducted – the Soviet 'Tsar Bomba' in 1961) over the Vienna International Centre.

BIOGRAPHICAL NOTE

ALEX WELLERSTEIN
is an assistant professor of Science and Technology Studies at the Stevens Institute of Technology in Hoboken, New Jersey, USA. He works on the history of nuclear weapons, with a focus on the historical development of nuclear secrecy policy. He is currently completing a book on the history of nuclear secrecy in the United States, from the Manhattan Project through the War on Terror, to be published by the University of Chicago Press. He also writes and maintains *Restricted Data: The Nuclear Secrecy Blog,* and is the creator of the NUKEMAP online nuclear weapons simulator.

Drilling for radioactive samples

The ultimate CTBT verification measure

BY WALTER D. DEKIN, PROJECT ENGINEER
LAWRENCE LIVERMORE NATIONAL LABORATORY
AND
WARD L. HAWKINS,
LOS ALAMOS NATIONAL LABORATORY

During his keynote address at the CTBT 2015 Science and Technology Conference in Vienna, Austria, CTBTO Executive Secretary Lassina Zerbo noted that the Integrated Field Exercise 2014 (IFE14) demonstrated 15 of the 17 on-site inspection (OSI) techniques, the two outliers being resonance seismology and drilling. Resonance seismology entails using microseismicity for mapping subsurface structure and anomalies to help identify site(s) for the application of drilling. Drilling, which applies many of the techniques developed by industry (e.g. oil and gas, minerals, geotechnical) has the potential to obtain radiological samples for laboratory analysis. Drilling to obtain those samples is potentially the most hazardous activity of all of the OSI techniques. It compounds the intrinsic industrial hazards of an industry drill site with the possible contamination from radioactive material.

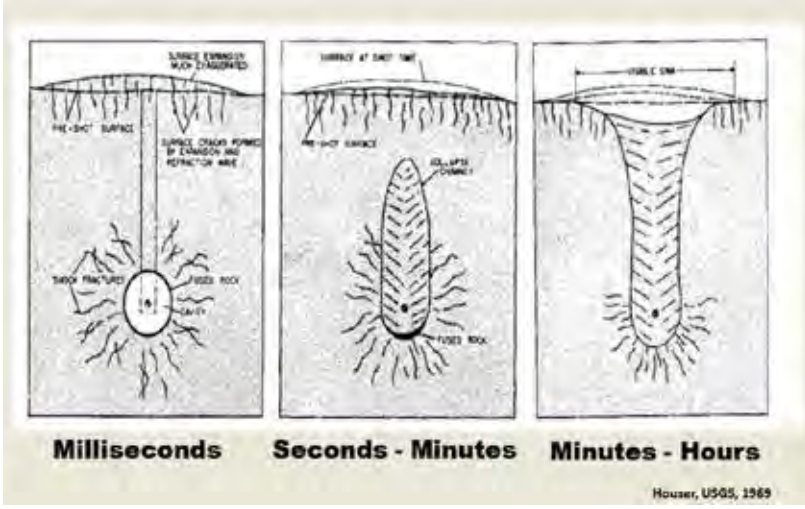
The steps necessary to accomplish drilling to recover radioactive samples during an OSI in a safe manner are summarized succinctly in the current Draft OSI Operational Manual as follows:

"Drilling is understood to entail the process from preparations [for drilling] in the Operations Support Centre (OSC) through the departure of the drilling team [and equipment] from the (territory of the) Inspected State Party (ISP). The objective of drilling is to obtain data indicating whether a nuclear explosion has occurred in violation of the Treaty. This objective is met by taking representative radiation measurements or radioactive samples to confirm or discount the presence of the radionuclides of interest as specified in Annex 1.4."

To understand what this might entail, it is necessary to visualize what occurs when a nuclear device is detonated underground.

A rotary drill rig, which is capable of drilling to over 1,000 metres depth in all types of formation (alluvial deposits to granite). This is by far the most complex and demanding drill rig.

In the first milliseconds after detonation, the pressure and temperature of the explosion shock wave form a cavity at the point of the detonation, a crush zone extends outward from the cavity, and fractures are formed in the rock formation beyond the crush zone. Within seconds to minutes, as the pressure subsides and the temperature cools, a zone of rubble forms as the cavity collapses, forming a rubble "chimney." The cavity collapse phenomena depend on the size and depth of the detonation and the geological formation in which the detonation occurred. A visible depression on the Earth's surface may form if the chimney reaches the surface.



Creation of an underground nuclear explosion chimney.

The fracture and crush zones and the chimney would be the sampling target of the drilling activity. From those zones it is possible to extract samples that may provide clarity as to whether a nuclear explosion has occurred.

CONCEPT OF OPERATIONS

There are many things to consider when contemplating such a drilling operation. These can be described as the Concept of Operations which includes:

- **Requirements, Regulations, Permits**

- **Drilling Site Selection:**
  Drilling site selection and development of the drill pad (the area where the drill rig and support equipment is set up) will depend on the terrain above the suspected nuclear detonation. Whether open and easily accessible, mountainous and remote, arid, temperate, or some combination of factors, each possible site presents challenges which must be addressed.

- **Drilling Pad**
  Size, Stability, Geology and Proximity to target.

- **Drilling equipment**
  The drill rig must be compatible with the drilling task. There is no "ideal" rig. Optimal response will require the selection of appropriate equipment.

OPERATIONAL PLANS

Drilling Operations, Health and Safety, Down Hole Logging, Sample Handling, and Decontamination and Remediation:

- **Drilling Operations - the Drilling Plan**
  The drilling plan identifies presumed locations of a suspected cavity created by a nuclear explosion with sufficient accuracy to provide target positions for penetration by the drill string for sampling. It details the required surface or underground preparation and logistical support for the Inspected State Party. The plan then provides the projected drilling schedule – subject to penetration rate and time since the event of interest. It further addresses drilling operation leadership, industrial safety, and radiological safety. Down hole logging identifies sample recovery and handling techniques that may be employed. Finally, the drilling plan details post-drilling activities, including inspection/decontamination of drilling equipment, remediation of the drill site(s), and waste disposal.

- **Health and Safety**
  Protection of personnel during drilling operations will require the implementation of a detailed safety plan that addresses industrial and radiation safety. The safety plan should include, but is not limited to:
  1. *Industrial Safety Concerns*
     Industrial safety cover the aspects of drilling operations at a high operational tempo, the presence of toxic or explosive gases, and the


Coiled tubing drill rigs are a "state of the art" drilling system which requires less infrastructure than a rotary drilling rig and can be adapted to many varying site conditions. These rigs are available in various sizes to meet many drilling requirements. Instead of utilizing a drill string that is made up of sections of pipe, a coiled tubing drill rig continuously advances tubing from a large drum which follows a drill bit that is rotated by the circulating drilling fluid.

need to plan for appropriate mitigating action for safety incidents.

2. *Radiological Safety*
   Protection of personnel from radiological hazards will depend on an effective monitoring programme for the drill site. A three-phased monitoring programme is anticipated: The first phase consists of monitoring of the drill rig and other potential release points using stationary instruments that record automatically and provide a remote readout which is monitored continuously. The second phase involves portable monitoring by trained personnel for particularly hazardous operations or the investigation of elevated radiation readings indicated by the stationary instruments. The third phase entails individual monitoring with passive and active dosimetry.

On-site technician ready for sample delivery.

- **Down Hole Logging**
  Various instruments are available which can be used to determine the continuous position and orientation of the drill hole as well as temperature and radiation levels. These survey instruments may be lowered inside the drill pipe on a wireline or be included in the drill string as a down-hole instrumentation package with up-hole recording and monitoring.

- **Sample Handling**
  The samples could consist of gases and/or solids. Radioactively contaminated liquids are also a possibility. Specific handling techniques depend on the nature of the sample and the level of radiation but will require shielded sample containers. The samples' chain of custody (COC) will have to be consistent with OSI COC procedures to ensure sample integrity.

  Consideration should be given to locating the laboratory used for sample analysis adjacent to the drill site to reduce transportation of the samples and limit potential personnel and environmental contamination.

- **Decontamination and Remediation of the Drill Site**
  The three items to be addressed after the cessation of drilling activities include:

1. The disposition of samples;
2. Equipment decontamination, equipment inspection, and preparation of equipment for transportation from the drill site to the Point of Entry (or Exit). The latter must be both adequate for release from the territory of the Inspected State Party and adequate for receipt at the storage facility or return to the contractor.
3. Decontamination and remediation of any "features" constructed to support the drilling operation, such as water storage basins, drilling mud retention basins or decontamination pads.

While sub-surface drilling to recover radioactive samples is potentially the most hazardous activity of all of the OSI techniques, with proper planning, training and attention to detail it can be accomplished safely.

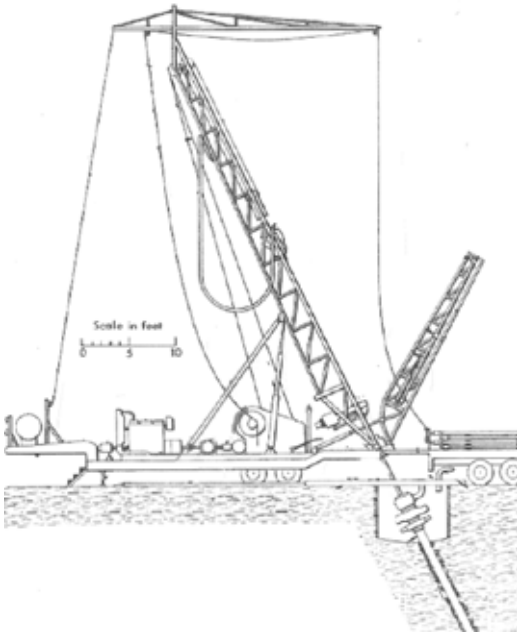
Sample removal from transport container.

THE BASICS OF DRILLING

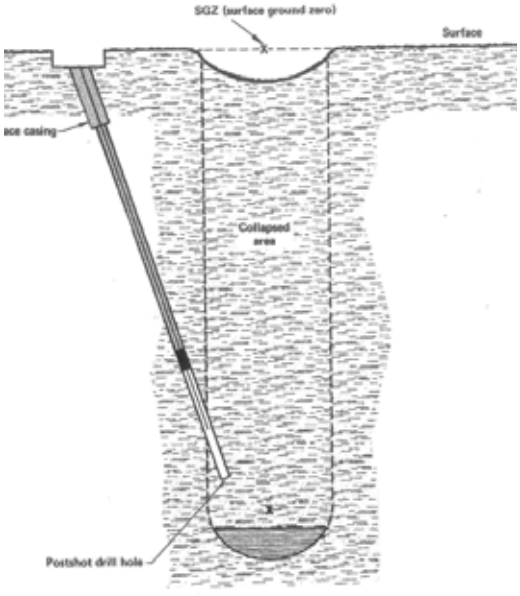
In rotary drilling for the recovery of oil or gas, a bit can be attached to a length of hollow drill pipe which is turned by the drill rig and the weight of the drill pipe advances the bit downward. As the bit goes deeper, additional sections of pipe (the drill string) are connected at the top of the hole.

Throughout the drilling process, a stream of fluid called drilling mud is pumped continuously to the bottom of the hole, through the bit, and back up to the surface. This special mud, which contains clay and chemicals mixed with water, lubricates the bit and keeps it from getting too hot. The drilling mud also carries rock cuttings up out of the hole, clearing the way for the bit.

The figure below represents a drill rig set up to drill towards the cavity.



The figure below details how the drilling progresses into the collapsed area or chimney to allow the collection of radioactive samples.



As the drill string advances into the collapsed area, the drilling mud will migrate into the formation instead of returning the cuttings to the surface. This is an indication that it may be appropriate to attempt to recover samples from the fractured area.

IFE14 in Jordan was the most comprehensive OSI exercise so far, using 15 of the 17 foreseen OSI techniques. In this photo: Sampling for sub-soil radioactive noble gas.

BIOGRAPHICAL NOTE

WALTER D. DEKIN
led the Visual Observation Technical Sub-Team for the Integrated Field Exercise 2014 (IFE14) from 3 November to 9 December. Over the last 19 years he has served in various positions of authority and responsibility for Lawrence Livermore National Laboratory, United States, including Test Director. He has fielded horizontal and vertical emplaced nuclear weapons tests, overseen radionuclide sample recovery drilling and mining efforts, and has led multi-organizational teams conducting high hazard, high consequences experiments at the former Nevada Test Site, United States, since 1987.

BIOGRAPHICAL NOTE

WARD L. HAWKINS
is currently a Project Manager in the Los Alamos National Laboratory's Global Security Directorate. He manages a portfolio of projects that span multiple organizations and many areas of technology (including drilling for radioactive samples) that are focused on monitoring and verification of the CTBT, and other national security issues. Recently Ward was the Chairman of the multinational Scenario Task Force and the Control Team Leader for the CTBTO's on-site inspection Integrated Field Exercise conducted in Jordan late in 2014.

ART AND NUCLEAR TESTING

Featuring

Xiaoyu Li

Contemporary artist Xiaoyu Li has spent the last few years travelling between the United States and China, which has left a profound mark on her painting style and ideas. Although her work is heavily influenced by the works of Western masters, it also demonstrates a strong attachment to Chinese traditional art and conveys a complex combination of Western and Chinese aesthetics. Lately, she has been experimenting with how to portray the issues of nuclear radiation, explosion and testing through art.

Why do you make art?

Certainly I do not make art purely for the sake of art. Art is a path that allows us to understand reality, to understand real things, to understand life and not the other way around. Art gives us many possibilities.

Where do you derive your inspiration from?

It is related to my cultural background. My roots are in China, so that is the basis of my inspiration. On the other hand, my inspiration comes from the most trivial things, inspiration can strike in the most unexpected places….

How do you feel about the fact that your artworks presented at this year's International Day against Nuclear Tests at the UN in Vienna?

I am very thankful and happy about that. It is a very important topic for me how to deal in an artistic way with nuclear testing and nuclear weapons. I really hope that the danger and cruelty of nuclear tests can be demonstrated in my art.

At the event to mark the International Day against Nuclear Tests in Vienna, Xiaoyu Li made a brief personal statement:

As a twenty-year-old, I have not experienced as much as you have. But I understand that war will bring nothing but destruction and death, bring hatred to human beings, but I'm still far from knowing what nuclear tests and nuclear weapons will bring us.

Artist Xiaoyu Li speaking at the event marking the International Day against Nuclear Tests, Vienna, Austria.

As an artist, I can show you the beauty, the kindness and happiness through art forms, and I can also show you the ugliness, badness and terror of the world after nuclear explosions and nuclear tests. I hope that by doing so, the danger and cruelty of nuclear tests can be demonstrated.

The ultimate goal of art is to eulogize peace. By a series of art shows and exhibitions, artists around the globe will be able to enhance the awareness of nuclear tests, to fight against any anti-peace activity, and to push for the elimination of nuclear tests, to bring an end to threats and hatred.

Thanks for the invitation from the United Nations. It is my honour and responsibility to be here, and like all of you sitting here today, I sincerely wish for this exhibition to be a success, and a world full of love.

Thank you very much!

ART FOR THE TEST BAN

Executive Secretary Lassina Zerbo addressing the event marking the International Day against Nuclear Tests on 28 August 2015 at the Vienna International Centre. The event was co-hosted with the Permanent Mission of Kazakhstan to the UN Vienna; the Chinese Artists' Association sponsored a reception.

Against Nuclear Testing – For World Peace
Artist: Zhao Yushen, China

At the initiative of Kazakhstan, 29 August was declared as the International Day against Nuclear Tests by the UN's General Assembly in 2009. The day aims to raise awareness about the dangers of nuclear tests and calls for a total ban. The date marks both the first nuclear test conducted at the Semipalatinsk nuclear test site in 1949, as well as the site's closure in 1991 by modern-day Kazakhstan.

This year's celebrations of the International Day against Nuclear Tests featured works by artists from Austria, China, Kazakhstan, and the United States which were shown in China, at the CTBTO's headquarters in Vienna, Austria, as well as at United Nations headquarters in New York, United States.

The works of art on display showed the variety and diversity of experiences and of creative expression. Mediums ranged from Chinese calligraphy, to painting to photo collages. The differences in the tone and emphases of the artwork also demonstrated the freedom which art offers to engage with nuclear testing on a personal level. While some artwork was disquieting in showing the effects of nuclear tests, other exhibits were ironic and darkly satirical, and most looked hopefully towards a future free of nuclear weapons, conveying messages of peace. Nonetheless, they all seemed to agree on one point: that banning nuclear tests and eliminating weapons should be an international priority.

A catalogue of the exhibits is available on the CTBTO website: ctbto.org/specials/international-day-against-nuclear-tests-29-august/

CTBTO Executive Secretary Lassina Zerbo with U.S. artist Clay Lipski (left) and Chinese artists Xiaoyu Li (right).

Clear Sky. Artist: Leyla Mahat, Kazakhstan

Dreams of Destruction, Artist: Zhou Hanfang, China

»29 August serves as a reminder that banning nuclear testing remains unfinished business.«

CTBTO Executive Secretary, Lassina Zerbo

Mourning of Peace. Artist: Zhan Yuehong, China

Underground Nuclear Test, Nevada Artist: Eric LoPresti, United States

Atomic Head Man Artist: Dan May, United States

PEOPLE

While visiting Nagasaki, Japan, in August 2015, CTBTO Executive Secretary **Lassina Zerbo** met **Makoto Takahara**, a "Hibakusha" from Hiroshima. Takahara was 17 when his city was devastated by the bomb dropped on 6 August 1945 and is one of an estimated 190,000 remaining survivors whose average age is now 80 years old.

The "Hibakusha" are the surviving victims of the atomic bombs which fell on Hiroshima and Nagasaki. While these individuals survived the immediate effects of the blasts, they have suffered from the effects of radiation sickness, loss of family and friends, and discrimination. In spite of their difficulties, many Hibakusha have been shining examples of turning their personal tragedies into a struggle to promote peace and to create a world free of nuclear weapons.

CTBTO Executive Secretary Lassina Zerbo (right) and Hiroshima survivor Makoto Takahara.

SCIENCE AND TECHNOLOGY 2015 AWARDS, VIENNA, AUSTRIA

Sophie Guillon, Université du Québec à Montréal, Canada, receives the Young Scientist award from Randy Bell, Director of CTBTO's International Data Centre Division.

Walter Dekin, Lawrence Livermore National Laboratory, USA, receives the 'Best Oral Presentation' award from Randy Bell.

Randy Bell presents the 'Best Poster' award to Thierry Héritier, who collected the award on behalf of Gilbert Le Petit, Alternative Energies and Atomic Energy Commission, France.

Munkhsaikhan Adiya (right), Mongolian Academy of Sciences, Mongolia, recieves the EU Star award from Ambassador Györgyi Martin Zanathy, Permanent Representative and Head of Delegation of the European Union to the International Organizations in Vienna.

Sophie Guillon (Geotop Research Centre in Geochemistry and Geodynamics, Université du Québec à Montréal, Canada) was awarded the Young Scientist award for *Variability in Subsurface Gas Transport in the Light of Field Experiments and Numerical Modelling* (S. Guillon, E. Pili, F. Barbecot, C. Carrigan).

Gilbert Le Petit (Alternative Energies and Atomic Energy Commission, France) received the award for the best poster for *High Resolution Electron Photon Detection System: A Major Breakthrough for Fission Product Analysis* (S. Generoso, P. Achim, M. Mireille, P. Gross, G. Le Petit) (collected by Thierry Héritier).

Walter Dekin (Lawrence Livermore National Laboratory, Livermore, CA, USA) gave the best oral presentation, entitled *Understanding the Challenges of On Site Inspection Drilling to Safely Recover Relevant Radiological Samples from an Underground Nuclear Explosion*.

Munkhsaikhan Adiya (Seismological Department, Institute of Astronomy and Geophysics, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia) was awarded the European Union Star Award for *Seismic Swarm near the Capital of Mongolia Investigated Using Double Difference Tomography* (M. Adiya, A. Schlupp , C. Dorbath , M. Calo , U. Munkhuu).

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