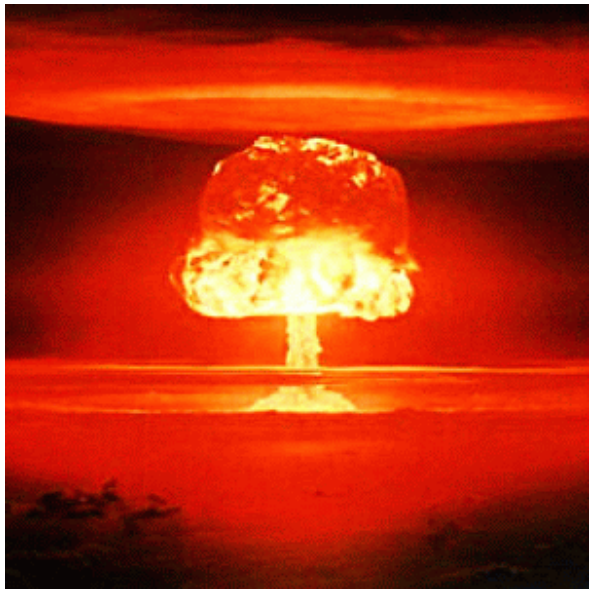

U.S. Nuclear Explosion over Bikini Atoll

THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY

& Why It Has Not Yet Come Into Legal Force

by
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The Comprehensive Nuclear-Test-Ban Treaty is considered one of the cornerstones in the effort for global arms control. This treaty's inception began in 1994. After two years of discussions and negotiations between governmental representatives, a final document was opened for signature in 1996. This was already twenty-six years after the most important treaty for the international disarmament and non-proliferation of nuclear weapons--the Treaty on the Non-Proliferation of Nuclear Weapons--came into legal force. The Comprehensive Nuclear-Test-Ban Treaty ("CTBT") seeks to control the development of nuclear weapons by specifically prohibiting all explosions of nuclear devices anywhere on the planet. By providing a total ban on nuclear testing, the CTBT seeks to prevent the new development of nuclear weapons and to deter any substantial improvements or changes to existing nuclear weapons.

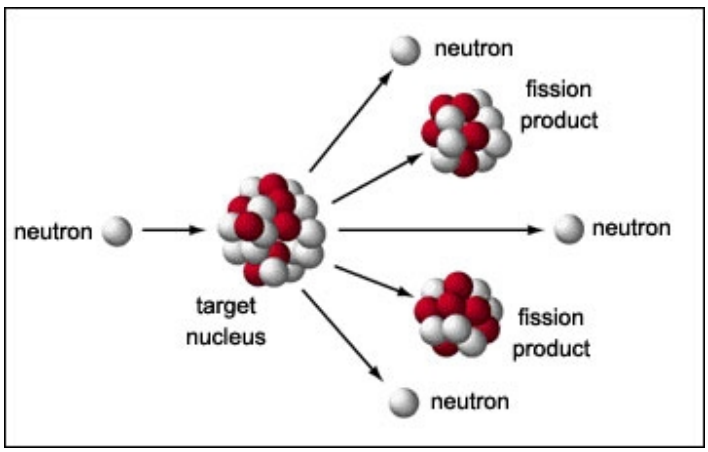
The two objectives of the CTBT are set-out in Article 1. All countries that are legal parties to the CTBT must adhere to these objectives which are stated as follows:

> 1. To undertake not to carry out any nuclear weapon test explosion or any other nuclear explosion and to prohibit and prevent any such nuclear explosion at any place under its jurisdiction or control; and
>
> 2. To undertake to refrain from causing, encouraging or in any way participating in the carrying out of any nuclear weapon test explosion or any other nuclear explosion.

A Short, Shallow Summary on the Development of Nuclear Weapons

The road to nuclear weapons began in earnest as the Nineteenth Century ended and the Twentieth Century began. In 1897, physicist J.J. Thomson working at the Cavendish Laboratory at Cambridge University, England, discovered the electron of the atom by measuring its response to both electric and magnetic fields. His hypothesis of how these electrons were positioned in relation to the nucleus was later proved to be incorrect by one of his former students, Ernest Rutherford, a New Zealander. Rutherford's most famous discovery took place while he was Professor at Manchester. In March 1911, he announced that each atom contained a positively charged nucleus. Investigations of these nuclei became known as 'nuclear physics'. Rutherford's discovery ultimately led to the 'splitting of the atom'. In 1919 when Rutherford was back at Cavendish Laboratory following in J.J. Thomson's footsteps, he managed to change several atoms of nitrogen into oxygen. He was able to identify particles orbiting around the nucleus of an atom which resembled the planets orbiting a sun. He realised these particles were electrons. At that time, it was believed the nucleus of an atom consisted of only one positively-charged particle called a proton. It was not until 1932 that James Chadwick, also at Cambridge, was able to distinguish that a second particle was present within the nucleus of the atom. Because this particle had no charge, it was called a neutron.

During the 1930's, scientists began trying to split different types of atoms by bombarding them with positively-charged electrons. This proved generally unsuccessful as the positive-charged nucleus repelled the bombarding electrons. It was not until 1934 when the Italian physicist, Enrico Fermi managed to bombard atoms with non-charged neutrons that nuclear physics made a leap forward. These same scientists paid little attention to an even greater discovery: matter disappears during bombardment, resulting in the release of huge amounts of energy. It was not until 1938 that scientists working for the Nazi regime in Berlin, Germany, recognised that in splitting the nucleus of an atom in half, an event of fission, large amounts of energy were released. This had enormous potential for a country soon to be at war.



At the end of 1939, the United States and Great Britain began coordinating their research efforts in a race to develop a useable nuclear (or, atomic) bomb before Adolf Hitler's Nazi scientists in Germany did. In 1942, this earlier nuclear physics research evolved into what became known as the Manhattan Project. In December 1942--slightly more than a year after the Japanese bombing of Pearl Harbor-- the United States government approved what ultimately became an investment in excess of $2 billion into the Manhattan Project. The Manhattan Project was authorized to build full-scale gaseous diffusion and plutonium plants, the compromise electromagnetic plant, as well as heavy water production facilities in a quest to develop the first nuclear bomb. While the

project began as a small research programme it expanded in the next three years to over thirty sites across the U.S., Canada and Britain before it technically achieved its goal in the Summer of 1945.

In August 1943, the governments of the United States, Great Britain and Canada signed the 'Quebec Agreement' by which they agreed to work together in the development of a nuclear bomb. Decisions were made by the Combined Policy Committee represented by each of these countries. The United States was chosen as the main site of research as well as for production of the nuclear bomb for several reasons. Although the scientists in Britain made significant theoretical contributions early on, Britain did not have the resources that the United States had. Also, with Great Britain at war with Germany and struggling for its survival, there was a strong likelihood that any structure in Britain housing the nuclear research and experimentation could be bombed.

The First Nuclear Explosions

In July 1945, the first successful nuclear bomb was tested in the desert by the Los Alamos research laboratory located in New Mexico, USA. Japan was warned within a few days of the nuclear test that they had one last chance to surrender to avoid utter destruction. It refused to surrender. On 6 August 1945, an American plane dropped the first nuclear bomb on the Japanese city of Hiroshima as it was the chief supply depot for the Japanese army. Again, the Allied Forces demanded that Japan surrender. Again, Japan refused. Seventy-two hours after the first bomb was dropped, a second nuclear bomb was released above Nagasaki on 9 August 1945.

The decision to use nuclear weapons against Japan was made by the Combined Policy Committee. At that time, no one had any real idea of what actually happened to people and buildings when or after a nuclear explosion occurred. The damage and devastation each bomb wrought on Hiroshima and on Nagasaki were staggering. The casualties immediately resulting from each bomb explosion were estimated as some 66,000 deaths and 69,000 injured in Hiroshima and some 39,000 deaths and 25,000 injured in Nagasaki. In Hiroshima, everything was destroyed within a one-mile radius. In Nagasaki, total destruction occurred in a half-mile radius, with major businesses and residential districts being shielded from the bomb. While the bomb dropped on Nagasaki was more powerful than the Hiroshima bomb (20 kiloton force compared to 15 kiloton force), the damage to Nagasaki was less than Hiroshima's due to geographical differences.

At the impact of a nuclear explosion, a huge amount of radiation is released as light; the intensity of which is comparable to the sun with temperatures and pressure comparable to the sun's interior. Radiation is the major cause of deaths and injuries of any person within an appreciable distance from the explosion. Nuclear explosions also release a wave of high pressure that is the major cause of damage to buildings and other structures.

For all the immediate damage and death, it was the aftermath of the Japanese nuclear explosions that revealed the full effect of nuclear weapons: widespread radiation poisoning, continued fallout of radioactive particles, a multitude of different cancers and birth defects of future generations which became prevalent in these two cities. Unlike other conventional bombs, nuclear weapons cause uncontrollable damage, immediate massive number of deaths and injuries with later-occurring radiation deaths. Radioactive particles remain in the soil and food sources for many, many decades.

In the aftermath of these history-making nuclear explosions, it was realised by the United Nations, governments and individuals including many of the same physicists who had developed

the bomb that there was no going back to a time without the threat of nuclear weapons and nuclear war. By the early 1950's it became clear that several countries were working on developing their own nuclear bombs. In these years following the nuclear bombings of Hiroshima and Nagasaki, there were many governments and individuals in the world who realised that any future conflicts between one or more countries with nuclear weapons could lead to the partial or even complete annihilation of the world. With the advent of the Cold War between the Union of Soviet Socialist Republics ("USSR") and the West, particularly, the United States, the massive stockpiling and the further development of nuclear devices by these countries became major concerns.

Nuclear Arms Control Leading to the CTBT

Between 1946 and 1958, the U.S. government tested 23 atmospheric nuclear bombs in the Bikini Atoll, part of the Marshall Islands in the Pacific. On 1 March 1954, the United States exploded its second (and most powerful) hydrogen bomb in the Bikini Atoll. Due to a miscalculation, the damage and effect of the bomb greatly excelled the U. S. government's predictions. The Bravo H-bomb vaporized three islands and threw radioactive debris over nearly 50,000 square miles. On a Japanese fishing vessel located 80 miles from the intense blast, its 23 fishermen became violently ill from radioactive sickness with one dying soon after.

In response to this incident, the Japanese Parliament demanded a suspension of nuclear testing. In April 1954, the Indian prime minister, Jawaharlal Nehru, called for an immediate "standstill agreement" on nuclear testing. By 1957 U.S. President, Dwight Eisenhower was also advocating for a nuclear test ban treaty. A speech made by Eisenhower added support for the establishment in 1957 of the International Atomic Energy Agency ("IAEA") which was charged with the dual responsibility of promotion and control of nuclear technology. The IAEA was conceived as an intergovernmental agency, independent from the United Nations but with direct access to the UN Security Council. The IAEA is headquartered in Vienna, Austria.

On 10 October 1963, three permanent members of the UN Security Council: the United States, the United Kingdom and the USSR, broke new ground when they agreed to the 'Treaty Banning Nuclear Weapon Tests In The Atmosphere, In Outer Space and Underwater' (also referred to as 'The Partial Test Ban Treaty' and 'The Limited Test Ban Treaty'). The motivation for these three large nuclear powers was the common goal of "an end to the contamination of man's environment by radioactive substances". As indicated by its title, this treaty neglected to specifically prohibit the testing of nuclear devices underground. There was a limited reference to underground testing as far as to prohibit such testing if it caused "radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control" the explosions were conducted. This treaty was never signed by the other two permanent members of the Security Council: France and the People's Republic of China despite both countries possessing nuclear know-how. France conducted its first nuclear test in 1960 and China did the same in 1964. With hindsight, the treaty did not hinder the development of nuclear weapons. Instead, nuclear testing moved underground with greatly increasing numbers of tests being conducted.

In 1968, the 'Treaty on the Non-Proliferation of Nuclear Weapons' ("NPT"), one of the most important international agreements concerning nuclear weapons, was opened for signature. The NPT came into legal force on 1 July, 1970 when in accordance with the treaty the United Kingdom, the USSR, and the United States along with forty additional countries all became legal parties to the NPT. This treaty's three objectives were to prevent the spread of nuclear weapons and weapons technology; to promote co-operation in the peaceful uses of nuclear energy; and to further the goal of achieving nuclear disarmament.

The NPT also established a safeguards system for compliance purposes with each of the member countries. The safeguards system requires that inspections be conducted by the IAEA verifying that no member country to the NPT is using nuclear material or facilities to develop nuclear weapons or other nuclear explosive devices. In addition, the NPT also requires conferences to be held every five years (counting from 1970) to review the operation of the treaty.

The NPT is the only binding, multilateral treaty currently in force which addresses the disarmament of nuclear weapons by the nuclear-weapon countries. As of the date of this article, 189 countries have become legal parties to the NPT. Only 4 countries remain outside the legal force of the NPT: **India, Israel, Pakistan and the Democratic People's Republic of Korea** ("DPRK" (i.e., North Korea) officially withdrew from the NPT in 2003).

Negotiating *The Comprehensive Nuclear-Test-Ban Treaty* 1994-1996

Between 1945 and 1996, over 2,000 nuclear tests were conducted globally. While the two main countries testing nuclear devices were the United States (1,000+) and the USSR (700+), China, France and the United Kingdom also conducted significant numbers of nuclear tests. In 1994, the United Nations disarmament body, the Conference on Disarmament, began formal negotiations in Geneva for a new treaty which would prohibit and prevent the testing of nuclear weapons and other nuclear devices. In 1996, the Comprehensive Nuclear-Test-Ban Treaty ("CTBT") opened officially for signature. Now some fifteen years later, despite being one of the best supported treaties in history (153 countries are now party to this treaty with an additional 29 countries signing but not yet ratifying it), the CTBT has still not come into legal force. The reason behind this lack of legitimacy is because the treaty stipulates and names forty-four countries which must become legal parties to it before it can come into force. Dr. Rebecca Johnson who attended and wrote about the CTBT negotiations in "Unfinished Business", said several years ago, "Assessing the CTBT twelve years after it was opened for signature, it is hard to escape the judgment that the negotiators handicapped the treaty with a provision that denied it operational viability (for a long time) and gave political reassurance only to its opponents." (See, "Unfinished Business" reference following article.)

According to various sources including the UN Office for Disarmament Affairs, negotiations broke down over the 'entry into force' paragraph of the treaty. The entry into force paragraph is a triggering mechanism for each treaty as it defines how many countries must become legal parties to the treaty before it can be legally effective and in force. Discussions on this paragraph of the CTBT were complicated by the importance of the matter and a lack of time. Should the number of countries include all those countries already possessing exploding nuclear devices? Should it only include those countries who openly acknowledged they held nuclear weapons? Although unspoken, there were many country delegates who thought that any requisite list of countries should include the five declared nuclear powers--China, France, Russia, the United Kingdom and the United States (all defined as "nuclear weapon states" in the NPT)--*and* those countries possessing nuclear weapons but outside the NPT: India, Israel, Pakistan and the Democratic People's Republic of Korea (India and Pakistan tested nuclear weapons in 1998 while (North) Korea held nuclear tests in 2006 and 2009).

Many of the issues concerning the entry into force paragraph and other parts of the CTBT were political ones. Pakistan, India and China all had interlinking political concerns as did the Middle Eastern countries with Israel. While the progression of the entry into force paragraph was extremely convoluted, the proposal that was finally accepted stipulated that all forty-four countries listed in Annex 2 of the treaty had to become legal parties before the treaty could come into legal effect and force. These forty-four countries who became known as the 'Annex 2' countries were all of the participating members of the Conference on Disarmament as of 18 June

1995 and who also appeared in the 1995 and 1996 IAEA lists of countries with nuclear research or nuclear power reactors, respectively. The reference to "participating members" excluded Yugoslavia (a member of the Conference on Disarmament by name but barred from participation during its civil war) and Iraq (to meet US concerns that Saddam Hussein should be denied any opportunity to exercise leverage by threatening not to ratify).

As of the end of February 2011, nine of the original forty-four Annex 2 countries have not yet become legal parties to the CTBT. These nine countries are: **China, the DRPK (North Korea), Egypt, India, Indonesia*, Islamic Republic of Iran, Israel, Pakistan, and the United States of America.** Of these nine countries, six signed the CTBT in the Autumn of 1996 but have never ratified it. The DPRK, India and Pakistan have not even signed the CTBT.

The most important fact is that the CTBT cannot and will not apply until these last nine Annex 2 countries finally legally agree to it.

Ensuring Compliance with the CTBT

As discussed above, the CTBT legally prohibits any country from carrying out any nuclear weapon test explosion or any other nuclear explosion anywhere on the planet. Thus, the CTBT imposes a comprehensive worldwide ban on all nuclear explosions of any size and in any location. The CTBT sets out specific and comprehensive means and procedures for verifying whether member countries are complying with the treaty. The CTBT verification regime is composed of three main elements:

1. An International Monitoring System;
2. An International Data Centre; and
3. On-Site Inspections.

At the heart of the verification regime is the International Monitoring System. By the time the CTBT comes into effect there will be 337 facilities located around the world collecting data which will enable it to monitor whether a nuclear explosion has occurred, the magnitude of any such explosion and the location. Of the total 337 facilities, 321 will be monitoring stations and 16 will be radionuclide laboratories. As of February 2011, approximately 83% of the total 337 monitoring stations have been constructed. Of the present total of 281, 264 of these constructed stations are already certified and sending data on to the International Data Centre in Vienna, Austria, while the remaining 17 are having tests conducted on their viability before being certified.

Although nuclear testing can occur in any environment, the majority of the nuclear testing during the testing era took place underground, underwater or in the atmosphere. The International Monitoring System uses state-of-the-art, monitoring technologies to detect the energy released from an explosion or a naturally occurring event in each of these three environments. The monitoring technologies under the CTBT are:

> Seismic monitoring is used to detect and locate underground nuclear explosions. Any type of seismic event generates two types of seismic waves: body waves and surface waves. The magnitude of a seismic event is measured using the Richter scale. In the last

*Indonesia indicated it has initiated the ratification process for the CTBT in May 2010. No further news had been received on this.

ten years, approximately 275,094 earthquakes and two nuclear test explosions were detected and measured using the CTBT seismic equipment. One nuclear test explosion was detected in 2006 with the second in 2009; both detonated by the DPRK. Seismic measurement makes up the majority of the international monitoring system with 50 primary and 120 auxiliary seismic stations located in 76 countries around the world. The primary seismic stations are online continuously twenty-four hours a day, seven days a week with the data being relayed in real time to the International Data Centre. The auxiliary stations only provide information on request.

Hydroacoustic monitoring stations "listen" for sound waves under the oceans' water. Of the 321 monitoring stations, 11 stations will monitor sound waves hydroacoustically. Because sound waves travel far through water, 11 stations are sufficient to monitor the major oceans in the world. The hydroacoustic stations relay data twenty-four hours a day, seven days a week.

Laying cable for hydroacoustic stations (CTBTO)

Infrasound monitoring will detect and measure ultra-low frequency sound waves (inaudible to the human ear) emitted by large explosions in the atmosphere. There will be a total of 60 infrasound monitoring stations in 35 countries around the world measuring these sound waves. Similar to the other two monitoring stations, the infrasound data is relayed to the International Data Centre continuously every minute of the day, seven days a week.

Also, there is radionuclide monitoring technology which is complementary to the three waveform technologies described above. The radionuclide stations will measure the atmosphere for radionuclide particles (these are radioactive nuclide particles). The radionuclide measurements provide the smoking gun element of the system as it is only this technology that is able to confirm whether an explosion detected and located by one or more of the other technologies is indicative of a nuclear test. There will be 80 radionuclide stations with 40 of these having the added capacity to detect radioactive

forms of noble gases such as xenon and argon. Monitoring at these stations will be twenty-four hours a day, seven days a week. Additionally, there will be 16 radionuclide laboratories to support this technology.

Radionuclide station (CTBTO)

All the data collected by these monitoring stations are sent in near real time to the International Data Centre located at the headquarters of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization in Vienna, Austria. The data are processed immediately when they reach the International Data Centre. The first automated data product will be released within one hour after the data have been recorded at the monitoring station. The International Data Centre will distribute information in both raw and analyzed forms to every member country of the CTBT. All countries are treated the same with each country receiving the same information at the same time. When the DPRK (North Korea) carried out its nuclear tests in 2006 and in 2009, the member countries to the CTBT received information about the location, magnitude, time and depth of each of the nuclear tests within two hours.

The On-Site Inspections form the last part of the verification regime of the CTBT. If the data from the global monitoring stations indicate that a nuclear test has taken place, a member country can request an on-site inspection be carried out to collect evidence to determine whether a nuclear explosion – a violation of the CTBT – has occurred. While several on-site exercises have been held during the past fifteen years, no actual on-site inspection is allowed until the CTBT comes into effect.

Setting-Up the Work of the CTBT

The CTBT provides that a Comprehensive Nuclear-Test-Ban Organization will be established "to achieve the object and purpose of the treaty". Under a resolution passed in November 1996, the member countries agreed to set-up an interim organization which would be called, The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Organization ("Preparatory Commission"), to carry out the necessary and extensive preparation for the effective implementation of the CTBT. As described above, the CTBT has a strong technological foundation requiring much preparatory work to be completed in advance of the treaty coming into force.

The Preparatory Commission's specific obligations have included:

-Carrying out necessary preparations for effective implementation of the CTBT and preparing for the 1st session of the Conference of States Parties which will take place after the treaty comes into force;

-Focusing on the promotion of the signing and ratification of the treaty so that it can enter into force as quickly as possible; and

-Establishing a global verification regime to measure compliance by member countries which must be fully operational when the CTBT comes into force.

The Preparatory Commission is not part of the United Nations nor will the future permanent organisation, the Comprehensive Nuclear-Test-Ban Organization, be when it is established. Instead, each one is or will be an independent, international organization with a relationship agreement with the United Nations.

Other uses for the data from the International Monitoring System

As discussed above, huge amounts of data are collected daily by the different monitoring stations. These data can be used for purposes other than detecting nuclear explosions. For example, all the data are shared with tsunami warning centres with almost real-time information about the occurrence of any underwater earthquake with the effect of helping to warn people earlier and possibly saving lives. The data can also be used to better understand the oceans, volcanoes, climate change, the movement of whales, and many other natural occurrences.

Conclusion

To date, the Comprehensive Nuclear-Test-Ban Treaty has been significant in obstructing and even halting almost all nuclear testing despite not yet having any legal effect. This result has been achieved by both peer pressure and by the compliance to the CTBT by those countries who have already signed and ratified it. By banning all nuclear explosions, the CTBT discourages countries without nuclear weapons from developing functional and deployable weapons and also seeks to prevent those countries already possessing nuclear weapons from developing new and more sophisticated ones. The CTBT is an impressive, well-thought-out international treaty which includes a comprehensive verification regime capable of detecting nuclear explosions occurring anywhere in the world. At this time, the work by the Preparatory Commission to establish a fully-functioning International Monitoring System is almost complete. The huge support for and belief in the CTBT is reflected by the number of countries who are already parties to the treaty. What remains to be done is to have those remaining nine Annex 2 countries now ratify or sign and ratify the CTBT.

Once again, these remaining Annex 2 countries are: **China, the DRPK (North Korea), Egypt, India, Indonesia, Islamic Republic of Iran, Israel, Pakistan,** and **the United States of America.** If you are a citizen or resident of any of these nine countries, please contact your government directly and voice your position on the CTBT treaty.

For further information, please see the following resources:

1. The current website for the CTBT and the Preparatory Commission (referred to as the "CTBTO") found at: http://www.ctbto.org
2. The UN Office for Disarmament Affairs found at: http://www.un.org/disarmament
3. The UN publication: "Unfinished Business – The negotiation of the CTBT and the end of Nuclear Testing" by Dr. Rebecca Johnson, published by UN Publications 2009. The text can be found at: http://www.unidir.org/pdf/ouvrages/pdf-1-978-92-9045-194-5-en.pdf
4. Atomic Archive at: www.atomicarchive.com
5. Cambridge Physics at: http://www.cambridgephysics.org