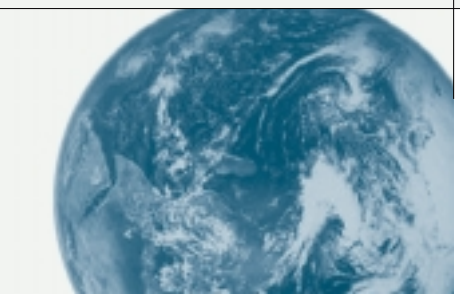

Conference on Facilitating
the Entry into Force
of the Comprehensive
Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

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1 Provisional agenda of the Conference


Photo taken by Mary Sherwin, NY

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

1.1 Provisional Agenda

1. Opening of the Conference by the Secretary-General of the United Nations.

2. Election of the President.

3. Adoption of the rules of procedure.

4. Adoption of the agenda and other organizational matters.

5. Election of officers other than the President.

6. Credentials of representatives to the Conference:
   (a) Appointment of the members of the Credentials Committee;
   (b) Report of the Credentials Committee.

7. Confirmation of the Secretary of the Conference.

8. Address by the Executive Secretary of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization.

9. Presentation of a progress report on cooperation to facilitate the entry into force of the Treaty.

10. General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.*

11. Statements by non-signatory States.*

12. Statement on behalf of NGOs.**

13. Consideration and adoption of a final document.

14. Any matters arising from paragraph 3 of Article XIV of the Treaty.

15. Adoption of the report of the Conference.

16. Closure of the Conference.

* As general guidance, it is assumed that speakers, at the discretion of the President, will talk for up to five minutes each.
** Time limit of approximately five minutes, at the discretion of the President.

1.2 Proposed Timetable

Tuesday, 25 September 2001

10 A.M.-1 P.M.

Item 1 Opening of the Conference by the Secretary-General of the United Nations.

Item 2 Election of the President.

Item 3 Adoption of the rules of procedure.

Item 4 Adoption of the agenda and other organizational matters (organization of work).

Item 5 Election of officers other than the President.

Item 6 (a) Credentials of representatives to the Conference: appointment of the members of the Credentials Committee.

Item 7 Confirmation of the Secretary of the Conference.

Item 8 Address by the Executive Secretary of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization.

Item 9 Presentation of a progress report on cooperation to facilitate the entry into force of the Treaty.

Item 10 General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.

3-6 P.M.

Item 10 *(continued)* General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.

Wednesday, 26 September 2001

10 A.M.-1 P.M.

Item 10 *(continued)* General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.

3-6 P.M.

Item 10 *(continued*) General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.

Thursday, 27 September 2001

10 A.M.-1 P.M.

Item 10 *(continued)* General exchange of views by ratifiers and signatories on facilitating the entry into force of the Comprehensive Nuclear-Test-Ban Treaty.

Item 11 Statements by non-signatory States.

Item 12 Statement on behalf of NGOs.

Item 6 (b) Report of the Credentials Committee.

3-6 P.M.

Item 13 Consideration and adoption of a final document.

Item 14 Any matters arising from paragraph 3 of Article XIV of the Treaty.

Item 15 Adoption of the report of the Conference.

Item 16 Closure of the Conference.

2 Conference objective and mechanism for CTBT entry into force

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

2.1 Objective

The objective of the Conference is to examine the extent to which the requirement for entry into force of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) has been met, and to decide, by consensus, what measures consistent with international law may be undertaken to facilitate the early entry into force of the Treaty.

The Conference is being convened by the United Nations Secretary-General, in his capacity as Depositary of the Treaty, at the request of a majority of those States that have already ratified it. The Treaty provides for the holding of such a conference if it has not entered into force three years after its opening for signature, on 24 September 1996, and at subsequent anniversaries until its entry into force.

2.2 Signature and Ratification

Under Article XI (Signature), the Treaty is open for signature by all States before it enters into force. Signature is accomplished when an authorized representative of a State signs the Treaty at United Nations Headquarters in New York.

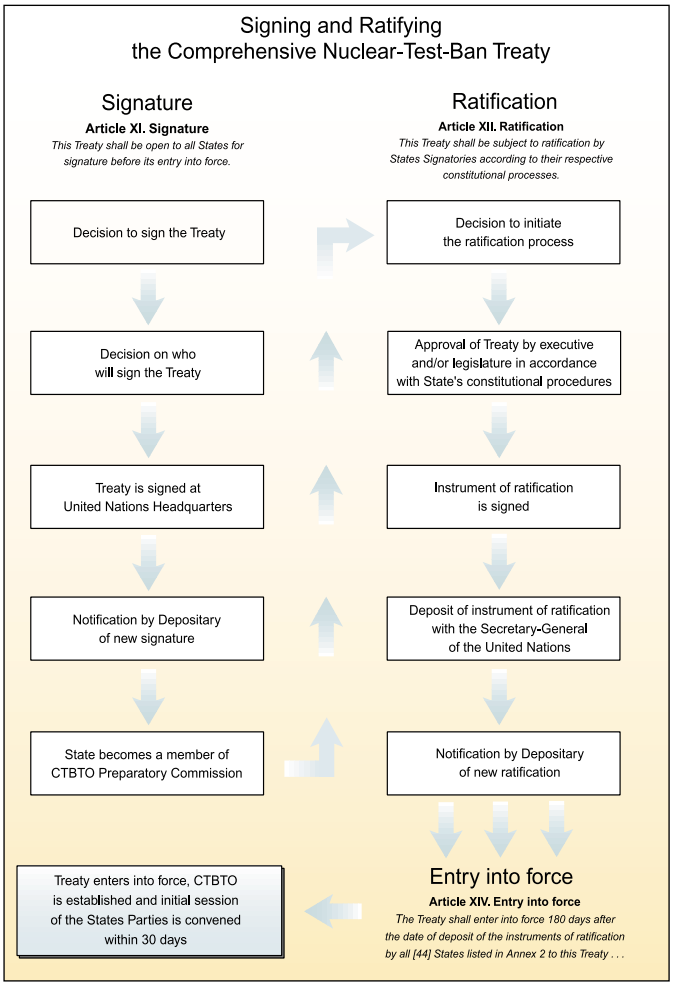
Ratification of the CTBT is a two-step process, first at the national and then at the international level. Under Article XII (Ratification), the Treaty stipulates that it be ratified according to a State's constitutional process. This usually entails the approval of the Treaty by the executive or the legislature of a State, or both.

- The instrument of ratification needs to be signed by the Head of State or Government or the Minister for Foreign Affairs, or another authorized representative. The instrument should contain the title of the person who has signed it, the date and the place of issue, the name of the Treaty (CTBT) as well as an expression of the will of the Government, acting on behalf of the State, to bind itself by the Treaty.

- The process of ratification is completed on the date on which the State deposits its instrument of ratification with the UN Secretary-General in New York.

2.3 Entry into Force

The CTBT will enter into force 180 days after the 44 States listed in Annex 2 to the Treaty have deposited their instruments of ratification with the UN Secretary-General. Annex 2 lists the 44 nuclear-capable States that formally participated in the work of the 1996 Conference on Disarmament and that possess nuclear reactors.



3 1999 Conference summary

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

3.1 1999 Article XIV Conference

From 6 to 8 October 1999, ninety-two States Ratifiers and Signatories met in Vienna to promote the early entry into force of the CTBT, as called for under Article XIV of the Treaty. The conference was also attended by representatives of States non-signatories, international organizations and non-governmental organizations.

Participants stressed the importance of universal adherence to the Treaty, and of the global verification regime being established by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). Several speakers also emphasized the urgent need for early entry into force of the Treaty, referring to the dangers of reviving the nuclear arms race.

3.2 Final Declaration

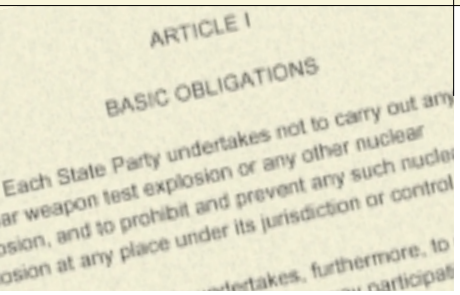
The States Ratifiers and Signatories unanimously adopted a Final Declaration, which, *inter alia*, called on States non-signatories to sign and ratify the Treaty as soon as possible, in accordance with their constitutional procedures, and to refrain from acts that would defeat the Treaty's object and purpose in the meanwhile.

The Final Declaration further:

- Called upon all States which had signed but not yet ratified the Treaty, in particular those whose ratification is needed for its entry into force, to accelerate their ratification process;
- Urged all States to sustain the momentum generated by the Conference by continuing to promote early entry into force at the highest political level;
- Called upon the Preparatory Commission to continue its international cooperation activities which demonstrate the benefits of the application of verification technologies for peaceful purposes in accordance with the Treaty's provisions;
- Urged all States to share legal and technical information and advice in order to facilitate the processes of signature, ratification and implementation by the States concerned;
- Appealed to all relevant sectors of civil society to raise awareness of, and support for, the objectives of the Treaty.

At the time of the convening of the 1999 Article XIV Conference, 154 States had signed the CTBT and 51 Signatory States had deposited their instruments of ratification.

4 Main provisions of the Comprehensive Nuclear-Test-Ban Treaty



Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

4.1 Background

Drafted at the Conference on Disarmament in Geneva and adopted by the United Nations General Assembly on 10 September 1996, the Comprehensive Nuclear-Test-Ban Treaty (CTBT) is the culmination of 40 years of work to ban nuclear explosions world-wide. *(For a brief history of the Treaty, please see insert 10.)*

The Treaty consists of a Preamble, 17 Articles with two Annexes, and a Protocol with two Annexes.

4.2 Preamble

The Preamble recalls the efforts by the international community to end all nuclear explosions and prevent the proliferation of nuclear weapons, thus making the world safer and more secure. It stresses the ultimate goal of eliminating nuclear weapons, and of "general and complete disarmament under strict and effective international control."

4.3 Basic Obligations

Each State Party undertakes not to carry out any nuclear weapon test explosion or any other nuclear explosion in any environment and to prohibit, prevent, and refrain from, in any way, participating in the carrying out of such explosion (Article I).

4.4 Implementation

The future Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is to be established in Vienna to ensure Treaty implementation and to provide a forum for consultation and cooperation. It will consist of three organs - the Conference of the State Parties, the Executive Council and the Technical Secretariat (Article II).

Each State Party needs to take any necessary measures to implement its obligations under the Treaty, including the establishment of a National Authority to liaise with the Organization and other State Parties (Article III).

4.5 Verification and Compliance (Article IV and the Protocol)

The verification regime will consist of four elements:

- The International Monitoring System;
- Consultation and clarification;
- On-site inspections;
- Confidence-building measures.

(For a detailed description, please see insert 7.)

The Conference of the States Parties or, in urgent cases, the Executive Council can take measures to redress a situation contravening CTBT provisions and to ensure compliance (Article V).

4.6 Settlement of Disputes

Disputes concerning the application or the interpretation of the Treaty are to be settled in accordance with Treaty provisions and in conformity with the UN Charter (Article VI).

4.7 Amendments and Review

At any time after the Treaty's entry into force, a State Party may propose amendments to the Treaty, the Protocol, or the Annexes to the Protocol. The proposed amendment shall be considered and adopted only by an Amendment Conference. The lists of international monitoring facilities in Annex 1 to the Protocol are subject to a simplified procedure for changes (Article VII).

A conference to review the operation and effectiveness of the Treaty will be held ten years after its entry into force (Article VIII).

4.8 Duration and Withdrawal

The Treaty shall be of unlimited duration. Each State Party has the right to withdraw from the Treaty, giving notice six months in advance, if it decides that extraordinary events related to the subject matter of the Treaty have jeopardized its supreme interests (Article IX).

Articles X, XI, XII and XIII deal with the status of the Protocol and the Annexes, and with signature, ratification and accession. *(For the signature and ratification process, please see insert 2.)*

4.9 Entry into Force

The Treaty shall enter into force 180 days after all 44 States listed in Annex 2 to the Treaty have deposited their instruments of ratification. If the Treaty has not entered into force three years after the date of its opening for signature, a Conference of States Ratifiers can be held to accelerate the ratification process in order to facilitate the Treaty's early entry into force (Article XIV). *(For more information, please see insert 2.)*

4.10 Additional Provisions

The Treaty and its Annexes shall not be subject to reservations (Article XV)**.**

The Secretary-General of the United Nations is the Depositary of the Treaty (Article XVI).

The Arabic, Chinese, English, French, Russian and Spanish texts of the Treaty are equally authentic (Article XVII).

4.11 Annexes to the Treaty

Annex 1 is a list of States, divided into six geographical regions.

Annex 2 lists the 44 States who need to ratify the Treaty for it to enter into force. *(For more information, please see insert 2.)*

4.12 Protocol

Protocol Part I describes the functions of the International Monitoring System (IMS) and the International Data Centre (IDC).

Protocol Part II sets out the procedures for on-site inspections.

Annex 1 to the Protocol lists the IMS facilities.

Annex 2 to the Protocol lists the characterization parameters for IDC standard event screening.

(The full Treaty text and a summary may be retrieved from the CTBTO web site: www.ctbto.org)

Status of States whose ratification is required for the Treaty to enter into force (as listed in Annex 2)

Conference on Facilitating
the Entry into Force
of the Comprehensive
Nuclear-Test-Ban Treaty

Legend:

- Signed
- Ratified
- Not Signed

State	Date of Signature	Date of Ratification
Algeria	15 October 1996	
Argentina	24 September 1996	4 December 1998
Australia	24 September 1996	9 July 1998
Austria	24 September 1996	13 March 1998
Bangladesh	24 October 1996	8 March 2000
Belgium	24 September 1996	29 June 1999
Brazil	24 September 1996	24 July 1998
Bulgaria	24 September 1996	29 September 1999
Canada	24 September 1996	18 December 1998
Chile	24 September 1996	12 July 2000
China	24 September 1996	
Colombia	24 September 1996	
Democratic People's Republic of Korea		
Democratic Republic of the Congo	4 October 1996	
Egypt	14 October 1996	
Finland	24 September 1996	15 January 1999
France	24 September 1996	6 April 1998
Germany	24 September 1996	20 August 1998
Hungary	25 September 1996	13 July 1999
India		
Indonesia	24 September 1996	
Iran (Islamic Republic of)	24 September 1996	
Israel	25 September 1996	
Italy	24 September 1996	1 February 1999
Japan	24 September 1996	8 July 1997
Mexico	24 September 1996	5 October 1999
Netherlands	24 September 1996	23 March 1999
Norway	24 September 1996	15 July 1999
Pakistan		
Peru	25 September 1996	12 November 1997
Poland	24 September 1996	25 May 1999
Republic of Korea	24 September 1996	24 September 1999
Romania	24 September 1996	5 October 1999
Russian Federation	24 September 1996	30 June 2000
Slovakia	30 September 1996	3 March 1998
South Africa	24 September 1996	30 March 1999
Spain	24 September 1996	31 July 1998
Sweden	24 September 1996	2 December 1998
Switzerland	24 September 1996	1 October 1999
Turkey	24 September 1996	16 February 2000
Ukraine	27 September 1996	23 February 2001
United Kingdom	24 September 1996	6 April 1998
United States of America	24 September 1996	
Viet Nam	24 September 1996	

Total Annex 2 States:	44
Total Signed:	41
Total Ratified:	31
Total Not signed:	3

5

Status of CTBT signatures and ratifications as of 18 July 2001

Conference on Facilitating
the Entry into Force
of the Comprehensive
Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

Legend:

- Signed
- Ratified
- Not signed

State	Date of Signature	Date of Ratification
Afghanistan		
Albania	27 September 1996	
Algeria	15 October 1996	
Andorra	24 September 1996	
Angola	27 September 1996	
Antigua and Barbuda	16 April 1997	
Argentina	24 September 1996	4 December 1998
Armenia	1 October 1996	
Australia	24 September 1996	9 July 1998
Austria	24 September 1996	13 March 1998
Azerbaijan	28 July 1997	2 February 1999
Bahamas		
Bahrain	24 September 1996	
Bangladesh	24 October 1996	8 March 2000
Barbados		
Belarus	24 September 1996	13 September 2000
Belgium	24 September 1996	29 June 1999
Belize		
Benin	27 September 1996	6 March 2001
Bhutan		
Bolivia	24 September 1996	4 October 1999
Bosnia and Herzegovina	24 September 1996	
Botswana		
Brazil	24 September 1996	24 July 1998
Brunei Darussalam	22 January 1997	
Bulgaria	24 September 1996	29 September 1999
Burkina Faso	27 September 1996	
Burundi	24 September 1996	
Cambodia	26 September 1996	10 November 2000
Cameroon		
Canada	24 September 1996	18 December 1998
Cape Verde	1 October 1996	
Central African Republic		
Chad	8 October 1996	
Chile	24 September 1996	12 July 2000
China	24 September 1996	
Colombia	24 September 1996	
Comoros	12 December 1996	
Congo	11 February 1997	
Cook Islands	5 December 1997	
Costa Rica	24 September 1996	
Cote d'Ivoire	25 September 1996	
Croatia	24 September 1996	2 March 2001
Cuba		

Status of CTBT signatures and ratifications as of 18 July 2001

Total States:	193
Total Signatures:	161
Total Ratifications:	78
Total Not signed:	32

For the current status of CTBT signatures and ratifications, please see the CTBTO web site: **www.ctbto.org**

State	Date of Signature	Date of Ratification
Cyprus	24 September 1996	
Czech Republic	12 November 1996	11 September 1997
Democratic People's Republic of Korea		
Democratic Republic of the Congo	4 October 1996	
Denmark	24 September 1996	21 December 1998
Djibouti	21 October 1996	
Dominica		
Dominican Republic	3 October 1996	
Ecuador	24 September 1996	
Egypt	14 October 1996	
El Salvador	24 September 1996	11 September 1998
Equatorial Guinea	9 October 1996	
Eritrea		
Estonia	20 November 1996	13 August 1999
Ethiopia	25 September 1996	
Fiji	24 September 1996	10 October 1996
Finland	24 September 1996	15 January 1999
France	24 September 1996	6 April 1998
Gabon	7 October 1996	20 September 2000
Gambia		
Georgia	24 September 1996	
Germany	24 September 1996	20 August 1998
Ghana	3 October 1996	
Greece	24 September 1996	21 April 1999
Grenada	10 October 1996	19 August 1998
Guatemala	20 September 1999	
Guinea	3 October 1996	
Guinea-Bissau	11 April 1997	
Guyana	7 September 2000	7 March 2001
Haiti	24 September 1996	
Holy See	24 September 1996	18 July 2001
Honduras	25 September 1996	
Hungary	25 September 1996	13 July 1999
Iceland	24 September 1996	26 June 2000
India		
Indonesia	24 September 1996	
Iran (Islamic Republic of)	24 September 1996	
Iraq		
Ireland	24 September 1996	15 July 1999
Israel	25 September 1996	
Italy	24 September 1996	1 February 1999
Jamaica	11 November 1996	
Japan	24 September 1996	8 July 1997
Jordan	26 September 1996	25 August 1998
Kazakhstan	30 September 1996	
Kenya	14 November 1996	30 November 2000
Kiribati	7 September 2000	7 September 2000
Kuwait	24 September 1996	
Kyrgyzstan	8 September 1996	
Lao People's Democratic Republic	30 July 1997	5 October 2000
Latvia	24 September 1996	
Lebanon		
Lesotho	30 September 1996	14 September 1999
Liberia	1 October 1996	
Libyan Arab Jamahiriya		
Liechtenstein	27 September 1996	
Lithuania	7 October 1996	7 February 2000
Luxembourg	24 September 1996	26 May 1999
Madagascar	9 October 1996	
Malawi	9 October 1996	
Malaysia	23 July 1998	
Maldives	1 October 1997	7 September 2000
Mali	18 February 1997	4 August 1999
Malta	24 September 1996	
Marshall Islands	24 September 1996	
Mauritania	24 September 1996	
Mauritius		
Mexico	24 September 1996	5 October 1999
Micronesia (Federated States of)	24 September 1996	25 July 1997
Monaco	1 October 1996	18 December 1998
Mongolia	1 October 1996	8 August 1997
Morocco	24 September 1996	17 April 2000
Mozambique	26 September 1996	
Myanmar	25 September 1996	
Namibia	24 September 1996	29 June 2001
Nauru	8 September 2000	
Nepal	8 October 1996	
Netherlands	24 September 1996	23 March 1999
New Zealand	27 September 1996	19 March 1999
Nicaragua	24 September 1996	5 December 2000
Niger	3 October 1996	
Nigeria	8 September 2000	
Niue		
Norway	24 September 1996	15 July 1999
Oman	23 September 1999	
Pakistan		
Palau		
Panama	24 September 1996	23 March 1999
Papua New Guinea	25 September 1996	
Paraguay	25 September 1996	
Peru	25 September 1996	12 November 1997
Philippines	24 September 1996	23 February 2001
Poland	24 September 1996	25 May 1999
Portugal	24 September 1996	26 June 2000
Qatar	24 September 1996	3 March 1997
Republic of Korea	24 September 1996	24 September 1999
Republic of Moldova	24 September 1997	
Romania	24 September 1996	5 October 1999
Russian Federation	24 September 1996	30 June 2000
Rwanda		
Saint Kitts and Nevis		
Saint Lucia	4 October 1996	5 April 2001
Saint Vincent and the Grenadines		
Samoa	9 October 1996	
San Marino	7 October 1996	
Sao Tome and Principe	26 September 1996	
Saudi Arabia		
Senegal	26 September 1996	9 June 1999
Seychelles	24 September 1996	
Sierra Leone	8 September 2000	
Singapore	14 January 1999	
Slovakia	30 September 1996	3 March 1998
Slovenia	24 September 1996	31 August 1999
Solomon Islands	3 October 1996	
Somalia		
South Africa	24 September 1996	30 March 1999
Spain	24 September 1996	31 July 1998
Sri Lanka	24 October 1996	
Sudan		
Suriname	14 January 1997	
Swaziland	24 September 1996	
Sweden	24 September 1996	2 December 1998
Switzerland	24 September 1996	1 October 1999
Syrian Arab Republic		
Tajikistan	7 October 1996	10 June 1998
Thailand	12 November 1996	
The former Yugoslav Republic of Macedonia	29 October 1998	14 March 2000
Togo	2 October 1996	
Tonga		
Trinidad and Tobago		
Tunisia	16 October 1996	
Turkey	24 September 1996	16 February 2000
Turkmenistan	24 September 1996	20 February 1998
Tuvalu		
Uganda	7 November 1996	14 March 2001
Ukraine	27 September 1996	23 February 2001
United Arab Emirates	25 September 1996	18 September 2000
United Kingdom	24 September 1996	6 April 1998
United Republic of Tanzania		
United States of America	24 September 1996	
Uruguay	24 September 1996	
Uzbekistan	3 October 1996	29 May 1997
Vanuatu	24 September 1996	
Venezuela	3 October 1996	
Viet Nam	24 September 1996	
Yemen	30 September 1996	
Yugoslavia	8 June 2001	
Zambia	3 December 1996	
Zimbabwe	13 October 1999	

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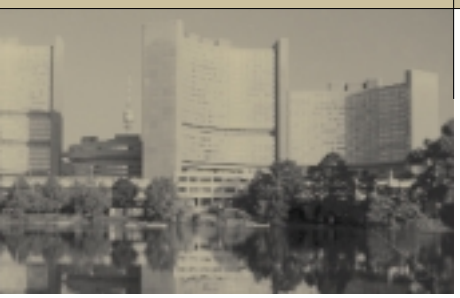
6 CTBTO Preparatory Commission



Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

6.1 Mandate

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization was established by the States Signatories at a meeting on 19 November 1996 at the United Nations in New York. It has a twofold mandate: to establish the global verification regime, which needs to be operational at the Treaty's entry into force, and to prepare for the first Conference of the States Parties. It also promotes the early entry into force of the Treaty. The Preparatory Commission shall remain in existence until the conclusion of the first Conference of the States Parties, whereupon its obligations and functions will be transferred to the CTBTO.

The Commission is a results-oriented international organization with a strong technical focus. Financed by the States Signatories, some 80 per cent of its budget is allocated to the build-up of the global verification regime. (Administrative costs are kept to 20 per cent.) The budget for 2001 is $83,499,500.

6.2 Status

A relationship agreement between the Commission and the United Nations was concluded in 2000. Under this agreement, Mr. Wolfgang Hoffmann, Executive Secretary of the Preparatory Commission, addressed the 55th United Nations General Assembly on the work of the Commission for the first time in October 2000.

6.3 Structure

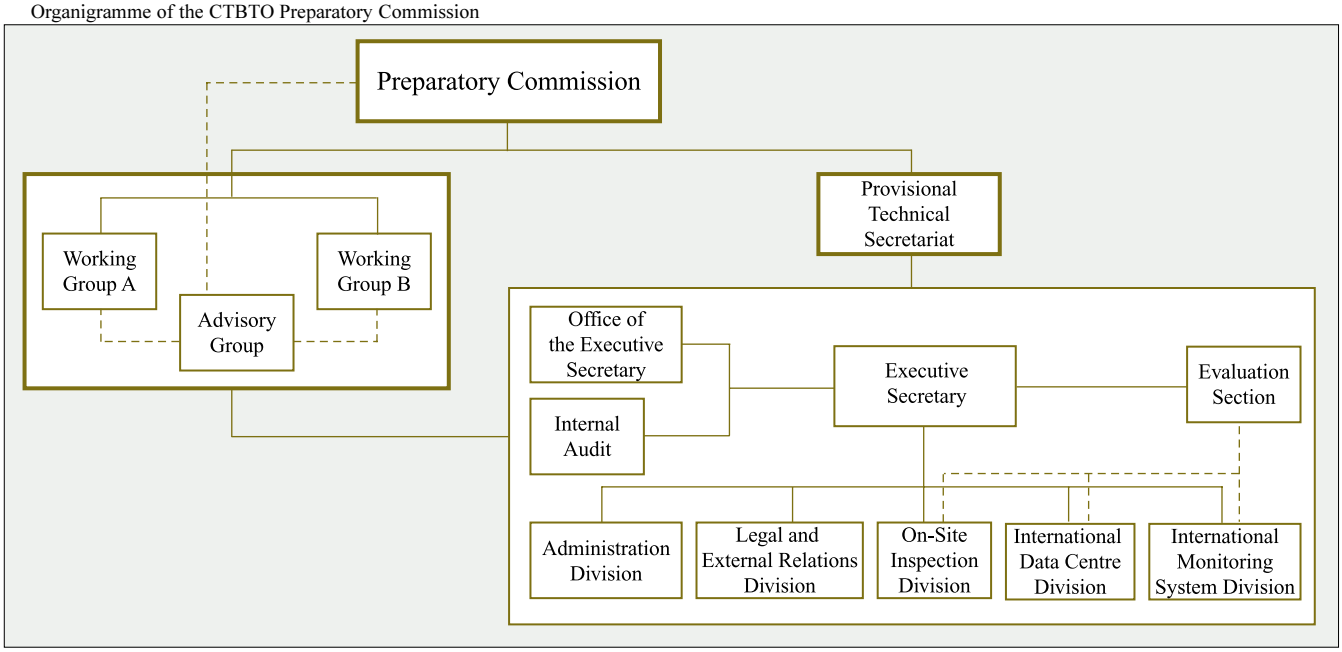
The Preparatory Commission consists of two main organs: a plenary body composed of all States Signatories and the Provisional Technical Secretariat.

The plenary body has three subsidiary organs:

- Working Group A on budgetary and administrative matters;
- Working Group B on verification issues;
- An Advisory Group, which consists of recognized experts from States Signatories. It advises the Commission and its subsidiary bodies on financial, budgetary and associated administrative matters.

The Provisional Technical Secretariat (PTS) started work in Vienna in March 1997. The multinational composition of the PTS reflects the global character of the organization, with 254 staff members from 69 States Signatories as at 30 June 2001.

Organigramme of the CTBTO Preparatory Commission



7 Global verification regime

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

7.1 Main Elements of the Verification Regime

The primary responsibility of the Preparatory Commission is to ensure that the Treaty verification regime is operational at entry into force. As stipulated under Article IV and in the Protocol, the verification regime consists of an International Monitoring System supported by an International Data Centre, consultation and clarification, on-site inspection and confidence-building measures.

7.2 International Monitoring System

Role in verification

The International Monitoring System (IMS) is the "ears" and "nose" of CTBT verification. According to Annex 1 to the Protocol, the IMS comprises a global network of 337 monitoring facilities (170 seismic, 11 hydroacoustic and 60 infrasound stations, the "ears", and 80 radionuclide stations and 16 laboratories, the "noses"). They monitor the Earth to detect and provide data on possible nuclear explosions and ambiguous events.

Four verification technologies

The seismic, infrasound, hydroacoustic and radionuclide monitoring technologies are designed to register vibrations underground, in the air and in the sea, as well as to detect radionuclides released into the atmosphere by nuclear explosions. Once fully established, the IMS will be capable of detecting nuclear explosions of very low yield detonated in any environment on Earth. *(On the build-up and certification status of IMS stations, please see insert 8.)*

Characterization and localization of an event

Seismic, hydroacoustic and infrasound monitoring technologies, which are based on waveform technologies, can detect and characterize an event as a possible explosion. In some cases, they cannot determine unambiguously that it is a nuclear explosion. Radionuclide technology, based on the collection and spectral analysis of atmospheric particulate matter, the monitoring of air samples and the analysis of noble gas content in the atmosphere, is the only technology that can confirm an event as having a nuclear origin. By applying the first three monitoring technologies, the IMS "ears", the time and location of an event can be obtained. It then takes a few days for the "nose" of radionuclide monitoring to provide the unambiguous evidence of a nuclear explosion.

International Data Centre

The IMS network is supported by the International Data Centre (IDC), which has been established at the Commission's headquarters in Vienna. Data from the IMS stations are transmitted through the Global Communications Infrastructure (GCI) to the IDC. Here, the data are processed, and, together with IDC products, released to Member States for further analysis and final judgement.

Global Communications Infrastructure

The Global Communications Infrastructure (GCI) is a satellite and ground communications network for the transmission of data between the IMS stations and the

IDC, and of data and products from the IDC to the national data centres and other authorities of States Signatories.

7.3 Consultation and Clarification

- States Parties should attempt to resolve, either among themselves or with the assistance of the Organization, any matters which may indicate possible non-compliance with the basic obligations of the Treaty.
- A State Party must provide clarification of an ambiguous event within 48 hours of receiving a request.
- If the requesting State Party considers the clarification obtained to be unsatisfactory, measures to redress the situation may be contemplated in accordance with Article V.

7.4 On-Site Inspections

- An on-site inspection (OSI) is provided for in the Treaty as a final verification measure, which may be requested by any State Party once the Treaty has entered into force, so as to clarify whether a nuclear explosion has been carried out in violation of the Treaty.
- An OSI would be requested for the purpose of gathering facts which might assist in identifying any possible violator.
- Approval of an OSI request requires 30 affirmative votes in the 51-member Executive Council.
- An inspection shall be conducted in the least intrusive manner possible, so as to protect the national security interests of the inspected State Party.
- The OSI regime involves applying specific techniques and requires experienced and trained inspection experts. *(On the status of OSI Operational Manual development, please see insert 8.)*

7.5 Confidence-Building Measures

Confidence-building measures (CBMs) serve a twofold purpose:

- They contribute to the timely resolution of compliance concerns relating to chemical explosions; and
- They assist in the calibration of IMS stations to enhance event location accuracy.

8 Build-up of the global verification regime

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

RIMARY SEISMIC STATION 21 NEAR TEHRAN, ISLAMIC REPUBLIC OF IRAN

ITE SURVEY AT INFRASOUND STATION 18, QAANAAQ, GREENLAND

DEPLOYING UNDERSEA CABLE, HYDROACOUSTIC STATION 8, RITISH INDIAN OCEAN TERRITORY, UNITED KINGDOM

ADIONUCLIDE STATION 23, RAROTONGA, COOK ISLANDS

8.1 International Monitoring System (IMS)

The task of establishing the IMS network of 321 monitoring stations and 16 laboratories, located in some 89 countries around the world, poses an engineering challenge unprecedented in the history of arms control. Some of these stations existed when the Provisional Technical Secretariat (PTS) started its work, and were - after some upgrading - able to be incorporated in the IMS network; others needed to be built from scratch. The establishment of this network of stations began in 1997.

IMS station establishment

Before upgrading or establishing an IMS station, a facility agreement or arrangement, or, as an interim measure, an exchange of letters, needs to be concluded with the host State to give the Commission the authority to operate within the territory of that State. Then, the PTS carries out a site survey to determine whether the station location defined in the Treaty is suitable. Such surveys also assess the equipment and construction work required, as well as the need for installation of satellite and other communication facilities. After installation and testing of a station, a rigorous process is followed before it can be certified as part of the IMS network.

Status of site survey and installation of IMS stations

Important progress has been achieved in the build-up of the International Monitoring System. The site survey programme is nearing completion - by the end of 2000, 90% of the site surveys for the primary seismic network, 55% for the hydroacoustic network, over 70% for the infrasound network and 73% for the radionuclide monitoring system had been completed. By the end of June 2001, installations had been completed at 103 stations, including some seismic stations which were already in existence, and the first 12 stations had been certified. Tables 1 and 2 below summarize the status of the IMS site survey and station installation programmes as of June 2001.

Table 1: Status of the Site Survey Programme as of June 2001

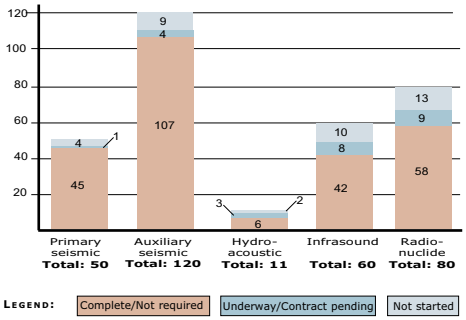
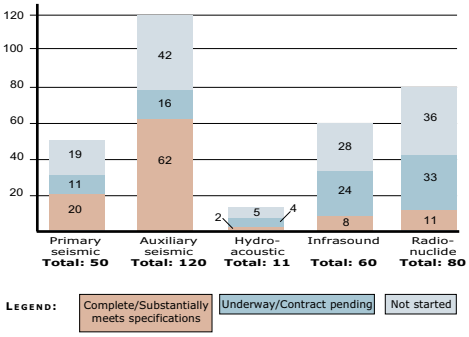


Table 2: Status of the Station Installation Programme



8.2 International Data Centre (IDC)

A major effort was made to connect IMS stations to the data processing pipeline of the International Data Centre (IDC). Currently, some 100 IMS stations are providing data to the IDC. The number of authorized users of the IMS data and IDC bulletins increased to 338 in June 2001, representing 48 States Signatories. On average, 21,000 IDC products are being made available to authorized users each month. Data quality and availability will further improve as more IMS stations become operational and the satellite communications system for data transmission is extended.

Global Communications Infrastructure (GCI)

The GCI provides communications links between IMS facilities and the IDC. As of June 2001, 134 GCI site surveys have been completed and 57 very small aperture terminals (VSATs) have been installed at IMS stations, national data centres (NDCs) and development sites. There are now 106 VSAT installations at various stages of development

8.3 Consultation and Clarification

Working Group B on verification issues is currently working on the development of the consultation and clarification process. *(On the consultation and clarification process, please see insert 7.)*

8.4 On-Site Inspections (OSI)

The major elements of the on-site inspection regime are the Operational Manual, equipment and inspectors. The Preparatory Commission has given high priority to the development of the OSI Operational Manual. An initial draft text of the manual has been available since April 2001. Considerable progress has been achieved in developing plans to test passive seismic equipment for aftershock monitoring, as well as equipment related to other techniques.

8.5 Confidence-Building Measures (CBMs)

The principal objective of CBMs is to contribute to the timely resolution of any compliance concerns arising from possible misinterpretation of verification data relating to chemical explosions. In 1999, the Preparatory Commission agreed on "Guidelines and Reporting Formats for the Implementation of Confidence-Building Measures".

CBMs also support callibration, the purpose of which is to improve knowledge of how vibrations propagate through the earth structure. This helps increase the accuracy of seismic event location. Between 1999 and 2001, a series of technical workshops have been held in Oslo, Norway, to develop a global calibration programme. Israel and Kazakhstan are examples of countries which have liaised with the PTS, and have provided information on chemical explosions for calibration purposes. The initial results of the calibration efforts are very promising. The International Data Centre (IDC) has also started to integrate information on the 'best travel time' of seismic signals into its seismic location system.

8.6 Training, Evaluation and International Cooperation

Training and quality assurance are important elements in all four components of the verification regime. So far, five Introductory Training Programmes in the IMS verification technologies, six in-depth Technical Training Programmes, six IDC Training Courses for prospective staff, two Introductory Training Courses for staff of national data centres, and a workshop on aspects related to transmission of data through the GCI have been held. In OSI, six workshops to address technical matters related to the OSI regime, six training courses, one field exercise and two tabletop exercises simulating elements of an OSI have been conducted. In addition, three workshops were organized in 2000 on evaluation and quality assurance issues.

A wide-ranging overview of the Treaty regime, activities of the Preparatory Commission and potential civil and scientific applications of Treaty verification technologies have been the subject of a series of international cooperation workshops. The workshops have been held in Vienna (Austria), Cairo (Egypt), Beijing (China), Lima (Peru) and Istanbul (Turkey). A total of 160 States and 289 participants have taken part and actively contributed to advancing Treaty understanding and Commission work.

9 Membership benefits

NTERNATIONAL COOPERATION WORKSHOP, ISTANBUL, TURKEY, MAY 2001

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

9.1 INTRODUCTION

Article IV (paragraph 12) of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) provides that:

"The States Parties undertake to promote cooperation among themselves to facilitate and participate in the fullest possible exchange relating to technologies used in the verification of this Treaty in order to enable all States Parties to strengthen their national implementation of verification measures and to benefit from the application of such technologies for peaceful purposes."

National Authorities will serve as the national focal points for liaison with the Organization and with States Parties.

International cooperation is thus an important vehicle through which States Parties may maximize benefits of their membership in the Treaty regime. The benefits span the political, technological, and scientific fields.

9.2 ENHANCEMENT OF GLOBAL SECURITY

- By banning any nuclear weapon test explosion or any other nuclear explosion in any environment, the CTBT constrains the development and improvement of nuclear weapons and thus contributes to nuclear non-proliferation and the enhancement of international peace and security.
- The Treaty can contribute to the protection of the environment.

9.3 NATIONAL CAPACITY-BUILDING

- Access to cost-free, high quality and authenticated International Monitoring System (IMS) data and International Data Centre (IDC) products, such as Event Lists, Reviewed Event Bulletins, etc., as well as national event screening services of the IDC.
- Access to state-of-the-art communications system provided by the Global Communications Infrastructure (GCI) technologies.
- Upgrade of national scientific capabilities in related technological areas through participation in IMS, IDC and on-site inspections (OSI) training courses and workshops.
- Access to the Experts Communication System (ECS) protected web site which offers registered users designated by States Signatories a secure and user-friendly forum for exchange of information via an e-mail or fax network, a meetings list, a discussion board and a documents database.
- Benefits from internationally-funded IMS site preparation, station establishment and upgrading, and equipment provision for the four verification technologies.
- Related local and international employment and training opportunities.

9.4 Advancement of International Cooperation

- International Cooperation workshops are organized for the purpose of enhancing understanding of Treaty significance and the work thereunder, as well as to explore appropriate ways to promote international cooperation among States.
- Support experience sharing and information exchange.
- Assistance in establishment of national data centres (NDCs) and/or regional data centres (RDCs) where States so wish.

9.5 Potential Civil and Scientific Applications of Verification Technologies

The Treaty stipulates four IMS technologies to monitor compliance with the comprehensive test-ban; namely seismic, hydroacoustic, infrasound, and radionuclide technologies. *(For a description of the four verification technologies and the build-up status of IMS stations, please see inserts 7 and 8.)* As effective and efficient as such technologies are for verification purposes, the IMS data and IDC products deriving from the monitoring technologies also have potential applications in the scientific, technological and environmental fields which can provide significant benefits to States.

Seismic:

- Support for national preparedness for disaster mitigation, early warning and rapid response capabilities, damage limitation, and search and rescue efforts;
- Tsunami warnings;
- Research on earthquake/volcanic eruption prediction/forecasting;
- Studies of the Earth's structure.

Hydroacoustic:

- Location of underwater volcanic events;
- Tsunami prediction;
- Monitoring of sea temperature and signs of global warming;
- Climate monitoring.

Infrasound:

- Detection of volcanic eruptions and possible effects on aviation;
- Oceanic swell research;
- Atmospheric and meteorological studies;
- Detection of meteor impacts in the atmosphere.

Radionuclide:

- Radiation monitoring on possible radioactive releases;
- Studies on natural radioactivity;
- Atmospheric monitoring and biological research;
- Environmental change tracking.

9.6 Membership in a Global Community of States

- The Preparatory Commission serves as a useful information pool on technology developments, supported by an Expert Communications System (ECS).
- In addition to promoting international cooperation activities among States, the Secretariat provides advice and support to States on various aspects relating to the establishment and operation of the global verification regime.
- Member States support and advance global efforts for a safer and more secure world.

10 Background material

Contents:
- Brief history of the CTBT
- Kerntechnik editorial
- Sample feature articles

Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty

New York, 25 - 27 September 2001

Brief history of the CTBT

1945
United States conducts its first nuclear explosive test, on 16 July. In August, two atomic bombs explode over Hiroshima and Nagasaki, Japan.

1949
Soviet Union conducts its first nuclear explosive test.

1952
United Kingdom conducts its first nuclear explosive test.

1954
Individuals and groups worldwide are increasingly concerned about radioactive fall-out from nuclear test explosions and the escalating arms race. Prime Minister Jawaharlal Nehru of India proposes for the first time a suspension of nuclear-weapon testing.

1958
Conference of Experts meets in August in Geneva to discuss the feasibility of monitoring a nuclear test ban. Expert tripartite (the Soviet Union, the United Kingdom and the United States) negotiations begin in October and come to an indefinite adjournment in 1962.

1959
Antarctic Treaty, providing for the demilitarization and denuclearization of the Antarctic continent, opens for signature.

1960
France conducts its first nuclear explosive test.

1963
Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water (Partial Test Ban Treaty), is signed by the United Kingdom, the Soviet Union and the United States. The Treaty does not include verification procedures or international inspections.

1964
China conducts its first nuclear explosive test.

1967
Treaty for the Prohibition of Nuclear Weapons in Latin America and, as amended in 1990, the Caribbean (Treaty of Tlatelolco), establishing a nuclear-weapon-free zone covering Latin America and the Caribbean, opens for signature.

1968
Treaty on the Non-Proliferation of Nuclear Weapons (NPT) opens for signature. The Preamble of the NPT and its Article VI include a specific reference to a linkage between nuclear-weapon States disarmament and non-proliferation.

1974
India conducts a nuclear explosion and asserts that it was for 'peaceful' purposes. Treaty on the Limitation of Underground Weapon Tests (Threshold Test-Ban Treaty), limiting the yield of such tests to 150 kilotons, is signed by the Soviet Union and the United States.

1976
Treaty on Underground Nuclear Explosions for Peaceful Purposes (Peaceful Nuclear Explosions Treaty), limiting the maximum yield of peaceful nuclear explosions to 150 kilotons, is signed by the Soviet Union and the United States.

1985
South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), establishing a nuclear-free zone in the South Pacific, opens for signature.

1990
Soviet Union conducts what is to be its last nuclear explosive test.

1991
Russia announces in January a four-month unilateral moratorium on nuclear testing, which is subsequently extended three times, the last of which is by presidential decree in July 1993. Parties to the Partial Test Ban Treaty hold an amendment conference to discuss a proposal to convert the Treaty into an instrument banning all nuclear-weapon tests for all time. The United Kingdom conducts what is to be its last nuclear explosive test.

1992
The Newly independent State of Kazakhstan announces that it will close its nuclear test site. France announces a unilateral moratorium on nuclear testing until the end of 1992, which is extended in January 1993. United States conducts what is to be its last nuclear explosive test. United States legislation (The Hatfield Amendment) establishes a moratorium on nuclear-explosive testing, which is extended in July 1993.

1993
Conference on Disarmament establishes Ad Hoc Nuclear-Test-Ban Committee to negotiate a Comprehensive Test-Ban Treaty (CTBT). The United Nations General Assembly welcomes this development.

1994
Russia advocates the signing of a CTBT in 1995, the 50th anniversary of the United Nations. China urges for negotiations to conclude a CTBT not later than 1996.

1995
The United States announces extension of its moratorium on nuclear testing until the entry into force of a CTBT. NPT Review and Extension Conference and, later, UN General Assembly call for the conclusion of CTBT negotiations in 1996. France announces it will halt all tests by May 1996 and sign a CTBT. Southeast Asia Nuclear Weapon Free-Zone Treaty (Treaty of Bangkok), establishing a nuclear-weapon-free zone in Southeast Asia, opens for signature.

1996
France conducts its last nuclear explosive test on 27 January. Two days later, France permanently closes its testing programme. African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba), establishing a nuclear-weapon-free zone in Africa, opens for signature. China conducts its last nuclear explosive test on 29 July and announces the beginning of a moratorium on nuclear testing effective the next day. Conference on Disarmament unable to reach consensus on the draft Comprehensive Nuclear-Test-Ban Treaty; 127 States sponsor a draft resolution by the UN General Assembly, which adopts the Treaty on 10 September 1996 by 158 in favour, 3 against, with 5 abstentions.

24 SEPTEMBER 1996
CTBT is opened for signature in New York; 71 States, including the five nuclear-weapon States, sign the Treaty on that day.

MAY 1998
India and Pakistan conduct nuclear explosive tests. Both countries then declare moratoria on further nuclear testing.

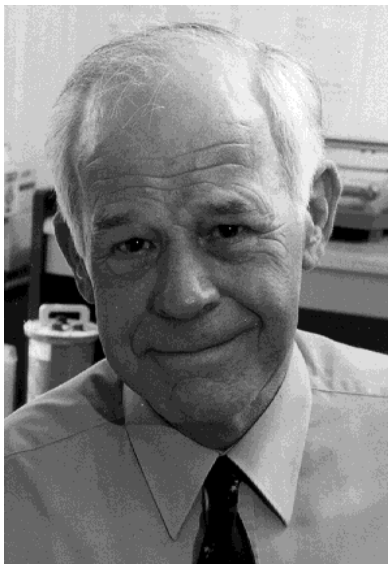
OCTOBER 1999
Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty is held in Vienna.

APRIL 2000
The Final Document of the NPT Review Conference stresses, *inter alia*:

"1. The importance and urgency of signatures and ratifications, without delay and without conditions and in accordance with constitutional processes, to achieve the early entry into force of the Comprehensive Nuclear-Test-Ban Treaty.
2. A moratorium on nuclear-weapon-test explosions or any other nuclear explosions pending entry into force of the Treaty."

SEPTEMBER 2000
At the United Nations Millennium Summit, the Secretary-General calls upon States, *inter alia*, to sign, ratify or accede to Treaties, in particular 25 core Treaties, including the CTBT. 13 States seize the opportunity to sign and/or ratify the CTBT.

MARCH 2001
The UN Secretary-General calls for the convening of the 2001 Article XIV Conference, which will take place in New York from 25 to 27 September.



Peter Marshall

Daniela Rozgonova

Wolfgang Weiss

Testing times: The road to a Comprehensive Nuclear-Test-Ban Treaty

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) has been the Holy Grail of arms control advocates for many years and it has taken over 40 years to achieve it.

International concern on the proliferation of nuclear weapons led the United Nations to establish a Five-nation Disarmament Sub-committee in April 1954.

In 1958, the United States proposed a Conference of Experts to consider how a nuclear test ban could be monitored. A meeting took place in Geneva, and in August 1958 a report was issued in which the experts concluded that an international control system of between 160 and 170 in-country monitoring stations could detect, locate and identify atmospheric explosions of about one kiloton and underground explosions greater than five kilotons. The experts recommended that unidentified signals could be resolved by on-site inspections. However, the failure to resolve the technical problems of seismic verification led to an indefinite adjournment of negotiations early in 1962.

Public concern over atmospheric radionuclide pollution increased following a large number of high yield nuclear tests by the USSR and the US. As a result of international concern and outcries against atmospheric testing, the USSR and US initiated discussions which culminated in a Partial Test Ban Treaty (PTBT) which banned nuclear tests in the atmosphere, underwater and in space. This Treaty did not include verification procedures or international inspections.

In 1962, the UN Eighteen Nation Disarmament Committee (ENDC) met for the first time in Geneva and proposals for a comprehensive test ban were tabled, including recommendations for a world-wide seismic monitoring network.

A major step towards arresting the spread of nuclear weapons came with the signing of the Non-proliferation Treaty (NPT) in 1968. The NPT is quite specific on the need to negotiate a multilateral nuclear test ban treaty and to work towards nuclear disarmament. However, little progress was made towards these two objectives until the early 90s.

As a result of pressure from the signatories of the NPT to have a robust and effective NPT, together with a willingness by the negotiators to achieve consensus, the CTBT was adopted by the UN General Assembly, and opened for signature on 24 September 1996. The Treaty has established a precedent as it includes a highly technical global monitoring and communication system as part of the verification regime.

This global verification regime supports the Treaty's specific aim of constraining development and qualitative improvement of nuclear weapons and of ending the development of new generation nuclear weapons. The Treaty thus contributes effectively to the prevention of both horizontal and vertical proliferation, and to the process of nuclear disarmament.

As of 26 March 2001, the CTBT has been signed by 160 States and ratified by 75. To enter into force, the Treaty must be signed and ratified by the 44 States with significant nuclear capability listed in Annex 2 to the CTBT. 31 of these States have now ratified the Treaty, including three of the five nuclear-weapon States and all but one of the members of the North Atlantic Treaty Organization.

The Preparatory Commission (PrepCom) for the Comprehensive Nuclear-Test-Ban Treaty Organization was established in New York on 19 November 1996 and consists of a plenary body composed of all States Signatories and a Provisional Technical Secretariat (PTS). The purpose of the PrepCom is to complete all the requirements necessary to complete the transition from signature to entry into force.

The PrepCom is a highly technical international organization financed by the States Signatories. As of 23 March 2001

the PTS has a staff of 252 from 69 different State Signatories to carry out its tasks. Its principal activities are the establishment of the global verification regime, and the promotion of the Treaty's signature and ratification for early entry into force.

As well as the global monitoring network, which uses state-of-the-art detection, communications and management techniques, the Treaty's verification regime includes consultation and clarification procedures. The verification regime also allows States Parties to request an on-site inspection to determine the source and nature of anomalous signals, and incorporates confidence-building measures.

The purpose of the verification regime is to detect non-compliance with the provisions of the Treaty, and it thus acts as a significant deterrent to a potential violator. It is interesting to note that while the global monitoring system is setting a precedent in multilateral arms control treaties, the establishment of the global network poses unprecedented engineering challenges, such as, for example, automatic stations which must operate on a continuous and real-time basis in some of the most remote and uninhabited regions of the world.

The global verification regime accounts for 80 per cent of the PrepCom budget, and must be operational when the CTBT enters into force. The PrepCom is therefore primarily concerned with establishing the worldwide network of stations that comprise the International Monitoring System (IMS). This network of 321 monitoring stations and 16 radionuclide laboratories is located in some 90 countries, and will be capable of recording vibrations from nuclear weapon tests fired underground, in the oceans and in the atmosphere. The network will also be able to detect radioactive materials released into the atmosphere. Four complementary types of stations are involved: seismological, hydroacoustic, infrasound and radionuclide. The first three technologies can be used to detect and locate explosions but only the radionuclide network can uniquely identify a nuclear explosion. Work on establishing this network is well under way, with many IMS stations now fully operational. While some existing stations have been integrated into the network, other stations have required substantial upgrading and in some cases stations have to be purpose-built.

To date, twelfe seismic stations have been certified by the PTS staff. Certification is an important process which takes place once a station is fully operational and has complied with the specifications approved by the PrepCom. It is anticipated that more stations will be certified before the end of 2001.

To collect and process the data from the IMS, an International Data Centre (IDC) is being established at the CTBTO headquarters in Vienna. The IDC will produce a bulletin of events detected and located by the IMS to enable States Parties to monitor the test ban, thus enhancing confidence in the effectiveness of the Treaty. The implementation of a Global Communication Infrastructure (GCI) began in late 1998. The GCI will allow data to be received on a continuous and real-time basis from IMS stations and will transfer data from the IDC to individual States Parties. At present over 100 IMS stations are transmitting data to the IDC and over 40 secure signature accounts, nominated by States Signatories, have been established to allow member states access to IMS data and other IDC products. This enables them to develop and improve their verification procedures for Treaty Monitoring. Data and IDC bulletin availability are constantly improving as more IMS stations are established, existing stations are upgraded and the communications system for data transfer is extended.

The decision as to whether or not a Treaty violation has occurred is the responsibility of individual States. To help resolve verification problems or uncertainties, a process of consultation and clarification is provided within the Treaty which enables States, with the assistance of the CTBTO Technical Secretariat if required, to resolve compliance issues within a specified time. If, following the consultation and clarification procedure, a State Party is not satisfied with the explanation given, it has the right to formally request an on-site inspection (OSI). The purpose of the OSI is to determine if a nuclear explosion has occurred. The request for an OSI must be approved by the Executive Council. The request must be based on data from the IMS or technical data from national facilities, as long as it has been acquired in accordance with international law. The on-site inspection procedure can only be invoked after the entry into force of the CTBT, and is expected to be a rare occurrence. Much work is currently being done within the PrepCom to establish the procedures, equipment and personnel required for the conduct of such inspections. This work will result in an Operations Manual which will specify all aspects of the conduct of an on-site inspection. The PrepCom is also conducting training programmes for personnel who can serve as inspectors after entry into force.

The verification regime is already proving its effectiveness, with the global network of verification stations and laboratories posing a formidable deterrent to potential violators. By banning all nuclear explosions, for whatever purpose, in any environment, the Treaty plays a crucial role in promoting global peace and security. So, nearly 50 years after the first nuclear test explosion and the first proposal to control nuclear weapon tests, the CTBT has finally been opened for signature. When it enters into force, the Treaty will mean that the testing times really are over.

Peter Marshall,
Daniela Rozgonova
and *Wolfgang Weiss*

This special issue of Kerntechnik provides an overview of the basic concepts applied for the design and the operation of the four individual networks of the international monitoring system. It describes the present status (April 2001) of their establishment. The specific detection methods of the four technologies as well as the principles of data analysis are presented together with typical results achieved so far. Special emphasis is on the description of the modules and procedures of the radionuclide network because these issues are believed to be of particular interest for the subscribers of Kerntechnik. The technical information on the networks is complemented by a description of the facilities and the procedures of the international data centre which represents the central facility for the compilation, processing, evaluation, and management of the huge amount of data which is continually produced by the networks.

The views expressed in this special issue are those of the authors, and do not necessarily reflect the views of the CTBTO Preperatory Commission.

Building Infrasound Station 55 in Windless Bight, Antarctica

During the last Antarctic summer, a team from the University of Alaska built the first infrasound station for the CTBTO Preparatory Commission in Antarctica. IS55 is part of the International Monitoring System (IMS), which comprises a global network of 321 stations, designed to detect any form of nuclear explosion in any environment. Altogether, 13 IMS stations will be located in Antarctica. Five of them existed previously as part of scientific networks and will need significant upgrading; the remainder have to be built from scratch. Located in a harsh environment with extreme weather conditions - persistently high wind speeds, severe snow drifts and extreme seasonal temperature differences (-40 Celsius to +30 Celsius) - access to the stations is in many cases confined to the local summer season only (December - March).

IS55 uses very sensitive microbarometers to detect low frequency sound waves from atmospheric explosions. For its eight sensors, set 1-3 km apart, to be able to detect an atmospheric explosion, the arrays are sited to avoid high winds. IS55 is the only known site on earth with essentially no winds. The station is equipped with a high quality power supply unit to ensure continuous operations. Currently data is being transmitted from Antarctica on the scientific communications network to the University of Alaska. In a few months, a link will be established with the International Data Centre (IDC) in Vienna. During the installation period, the local research base staff has been trained in operating the station.

IS55, which constitutes an important step in the build up of the IMS, is expected to be certified during the next Antarctic summer.

First infrasound station to monitor compliance with CTBT is certified

Infrasound Station 26 in Freyung, Germany, is the first infrasound station in the International Monitoring System (IMS) to be certified by the CTBTO Preparatory Commission. The IMS is a global network of stations that will monitor compliance with the Comprehensive Nuclear-Test-Ban Treaty. The network is designed to detect any form of nuclear explosion in any environment.

The station in Freyung, which was built from scratch over a period of twelve months, uses very sensitive microbarometers to detect very low frequency sound waves in the atmosphere which are produced by both natural and man-made events. It consists of an array of sensors located several kilometres apart. Each sensor is surrounded by a network of baffles which reduce wind noise.

The station's location in the middle of the Bavarian forest also reduces the level of interference caused by the wind. It is co-located with a primary seismic array, also part of the IMS, which has not been certified yet.

Information from IS26 is transmitted to the International Data Centre in Vienna via the Global Communications Infrastructure, where it is analysed and made available to the States Signatories through the regular Event Bulletins.

IS26 is managed and maintained by the Federal Institute for Geosciences and Natural Resources (BGR).

Facility Agreements

In order to establish a framework within which work may be conducted on the territory of States, the Preparatory Commission has concluded legal agreements or arrangements or exchanges of letters with States to regulate the activities of the Commission at over 290 monitoring facilities. Several International Monitoring System (IMS) Facility Agreements, which grant legal authority to the Preparatory Commission to work on State territory to establish, upgrade or maintain monitoring facilities, have also been concluded and have entered into force.

50 primary and 120 auxiliary seismic stations, together with 60 infrasound, 11 hydroacoustic and 80 radionuclide stations form the International Monitoring System (IMS), a global network of 321 stations which is supported by 16 laboratories. When fully operational, the IMS will be able to record acoustic signals in the atmosphere, underground or in the seas as well as sample radioactive material from a possible nuclear explosion anywhere in the world. Some 100 monitoring stations are already transmitting data to the International Data Centre (IDC) in Vienna via the satellite-based Global Communications Infrastructure.

DATA PROCESSING AT THE INTERNATIONAL DATA CENTRE (IDC)

Every day, around five gigabytes of raw data pour into the International Data Centre from monitoring stations around the world. Most of the data is collected and transmitted in a continuous stream, and it is the IDC's function to process, analyse and transmit this data to the Member States. States can request all the raw data, or they can chose to receive it in bulletin format. States can also request the IDC to provide data according to their own specific selection.

Seismic, hydroacoustic and infrasound data are timeseries, and they go through a similar processing and analysis 'pipeline' when they arrive at the IDC. Small differences in the processing and analysis between one technology and another are generally related to the processing parameters applied, the execution of particular algorithms in some cases, and the time at which processing steps are executed within the pipeline.

Within minutes of arrival at the IDC, timeseries data undergoes automated station processing. The output of this process is a list of signals detected within the timeseries from a single station, and a suite of attributes that describes each detected signal (e.g. arrival time, amplitude, frequency, direction, estimate of the travel path). The list of signal detections and attributes from all stations in the network are next input into the automated network processing system. The data undergoes three rounds of automated network processing, resulting each time in the production of a Standard Event List (SEL) at two, six and twelve hours respectively. The third SEL (SEL3) is reviewed by human analysts, who compile a Reviewed Event Bulletin (REB), currently within four to six days after the occurrence of an event. Sophisticated graphical decision support and analysis software is used to review the raw timeseries data in conjunction with SEL3, and to validate, or correct if necessary, the automated solutions. Senior analysts and scientists review the work of the first-line analysts as a means of quality assurance. Standard event screening criteria are then applied with the goal of screening out events consistent with natural or non-nuclear, manmade events.

Radionuclide processing differs in a number of details. One of these is the time schedule, as the propagation of radionuclides from the causative event to the sensors could take up to two weeks. Subsequent sample collection and measurement in the field takes up to two days for noble gas analysis, and up to three for particulate analysis. The radionuclide spectra then undergo automated station processing, which is followed by interactive analysis by human experts. Automated characterization and screening then categorizes the spectra into levels according to the number, type and relative amounts of nuclides present. The identification of anomalous levels of particular radionuclides triggers an atmospheric modeling operation to track the origin of the sample. This modeling is based on retrieved meteorological data and makes fusion of data from all four technologies possible. Standard Screened Radionuclide Event Bulletins (SSREBs) are produced when an anomalous radionuclide level is detected.

On average, Member States receive close to 21,000 segmented data and product deliveries per month from the IDC. The system continues to be developed and refined so that the IDC can meet demands for an increasing volume of data and range of IDC services.