

CTBTO Spectrum

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Who we are

The Comprehensive Nuclear-Test-Ban Treaty bans all nuclear weapon test explosions. The Treaty is a cornerstone of the international nuclear non-proliferation regime. It opened for signature in New York on 24 September 1996, and today has achieved strong worldwide support.

The CTBTO Preparatory Commission is an international organization consisting of a plenary body composed of all States Signatories and the Provisional Technical Secretariat. It carries out the necessary preparations for the effective implementation of the Treaty, and prepares for the first session of the Conference of the States Parties to the Treaty after its entry into force.

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2003 Article XIV Conference – An important step by Ambassador Yukio Takasu of Japan

The 2003 Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty (also known as the Article XIV Conference) was successfully concluded on 5 September with the unanimous adoption of the Final Declaration. The 2003 Conference attracted more political level participation than the 1999 Conference previously held in Vienna. Among 107 delegations were eight Foreign Ministers, including Minister Kawaguchi of Japan, and twenty Secretaries of State or Deputy Ministers. A letter dispatched by the Foreign Ministers of Austria, Finland and Japan, representing the host country and the current and past Conference Chairpersons respectively, urging their counterparts to join them at the Conference, contributed to attaining such a high level of participation.



ARTICLE XIV CONFERENCE, AUSTRIA CENTER, VIENNA, 3-5 SEPTEMBER 2003

It is certainly a source of disappointment, particularly to a country like Japan which is totally committed to the Treaty, that the CTBT has not entered into force seven years after its opening for signature. Those who promote the Treaty, however, should not feel too discouraged. Firstly, regarding the ratification of the Treaty by Annex 2 countries, an important step forward was achieved last July with the ratification by Algeria. It is hoped that the twelve remaining Annex 2 countries will follow soon. At a meeting during the Conference, the Foreign Ministers resolved to maintain political momentum by working together in their continued appeals to the 12 Annex 2 countries to sign and ratify as soon as possible. Secondly, with 17 additional ratifiers since the last Article XIV Conference, the universality of the Treaty and therefore its effectiveness as a legal and moral deterrent to nuclear explosions was enhanced. The Final Declaration called upon all States to continue a moratorium on all nuclear explosions and to refrain from acts which would defeat the object and purpose of the Treaty pending its entry into force. Thirdly, the building-up of the verification regime is advancing well and is serving as a confidence-building measure even before the actual entry into force of the Treaty.

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Editorial



This September, one hundred and two States Signatories and five other States came together to participate in the 2003 Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty (Article XIV Conference), many of them at ministerial or Secretary of State level. The Conference took place in Vienna from 3 to 5 September, and underlined clearly the international community's strong support for the Comprehensive Nuclear-Test-Ban Treaty (CTBT). At the time of writing, 170 States have signed and 108 have ratified the Treaty.

In her opening address to the Conference, the Austrian Minister for Foreign Affairs, Benita Ferrero-Waldner, stated that the Conference could not have come at a more appropriate moment: "The issue of weapons of mass destruction dominates the international agenda and is a major ingredient of some of the most dangerous crises the world is facing today. The prevention of proliferation and of testing of such weapons therefore is of the utmost urgency." Clearly, many governments and citizens are concerned about international developments since the 2001 Article XIV Conference. This concern is also reflected by the large number of non-governmental organizations and media representatives who attended the Conference. Their participation is an indication of the Treaty's relevance, and of the worldwide interest in nuclear non-proliferation and global security.

This issue of CTBTO Spectrum looks at the results of the Article XIV Conference. The cover story by Ambassador Yukio Takasu provides a Member State's view of the Conference. As an overarching theme, this issue focuses on the benefits of signing the Treaty, both political and those deriving from the potential civil and scientific applications of the verification technologies. An interview with Minister Benita Ferrero-Waldner, and a special feature article by Hein Haak, a Dutch infrasound expert, concentrate on this theme. As usual, we include an overview of the Commission's work over the past six months, including an update on the latest session of the Preparatory Commission.

Wolfgang Hoffmann
Executive Secretary
Preparatory Commission for the Comprehensive
Nuclear-Test-Ban Treaty Organization

Results of the Article XIV Conference

The 2003 Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty concluded on 5 September in Vienna. Delegates adopted a Final Declaration that stressed the importance of a universal and effectively verifiable comprehensive Treaty as a major instrument of nuclear disarmament and non-proliferation. "The prevention of the proliferation of weapons of mass destruction is one of the most important challenges facing the world", the Final Declaration stated. States participating in the Conference reaffirmed that "the CTBT has an essential role to play in strengthening global peace and security."

For the first time in its history, the Conference adopted an action plan with twelve specific practical measures to promote entry into force, appended to the Final Declaration. These include, *inter alia*, promoting understanding of the Treaty and demonstrating the benefits of the civil and scientific applications of the verification technologies, organizing regional seminars in order to increase awareness of the important role of the Treaty, and providing legal assistance on implementation measures and on national ratification processes. The Provisional Technical Secretariat is requested to act as a 'focal point' where information about activities undertaken by States Signatories is collected.

Further consultations on the implementation of the action plan will be held at a special meeting of States Signatories which takes place on 24 November 2003. ■

Notes & quotes

Seminar on CTBT Membership Benefits

A well-attended seminar on the benefits of the CTBT was held on the margins of the 2003 Article XIV Conference on 4 September in Vienna. Ambassador Tom Grönberg, Permanent Representative of Finland, opened the seminar and welcomed the participants on behalf of the Conference Presidency. The seminar was organised by the Provisional Technical Secretariat and chaired by Peter Marshall, a British seismic expert.

In his presentation, Peter Marshall provided an overview of the various benefits of Treaty membership, covering the political benefits and the potential benefits which may derive from the application of the verification technologies for civil and scientific purposes. He also cited examples of membership benefits such as training of State Signatory personnel. As a result of the Preparatory Commission training programme, personnel return home with enhanced knowledge and skills, both scientific and technical. This knowledge can be used to improve national competence in verification and to provide national governments with better advice on Treaty related political and technical issues.

Robert Kleywegt, a South African seismologist, presented a regional perspective on possible applications of the CTBT seismic network. He pointed out that at present Africa has no appropriate level of data to assess the potential effects of natural hazards such as large earthquakes. "The CTBTO seismic network could provide much needed data and be the catalyst for the development of sub-regional and local seismic networks, while the IDC's bulletins and information from other global databases could be accessed to generate the seismic history component for seismic hazard studies."

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2003 Article XIV Conference...

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Where should we go from here? The Final Declaration includes a list of various concrete measures. The key is to maintain momentum and keep the CTBT high on the political agenda. At the global level, we should make use of occasions such as the 2005 NPT review process, where particular importance should be attached to the urgency of the early entry into force of the CTBT and of maintaining a nuclear test moratorium. We should also aim at holding another CTBT Friends ministerial meeting on the occasion of the United Nations General Assembly next autumn. Furthermore, bilaterally and regionally, we should continue to engage ourselves actively in soliciting the remaining 12 Annex 2 countries, perhaps targeting particularly those closer to ratification. To promote further universalization, we should support and encourage international cooperation projects that make use of verification technology, including its application to civil and scientific purposes. Lastly, I strongly hope that the additional measures to be discussed by ratifying States in accordance with the Final Declaration will make a real contribution to the promotion of the early entry into force of the Treaty. ■

Biographical note



Ambassador Yukio Takasu, Permanent Representative of Japan to the International Organizations in Vienna since 2001, joined the diplomatic service in 1969 and served in various positions in the United Kingdom, Malaysia, Indonesia and at the United Nations in New York. He studied at the University of Tokyo and at Oxford University.

In the Foreign Ministry in Tokyo, he was responsible for Japan's policy on Western Europe and on the United Nations (1988-1992). In September 1993, Mr Takasu was appointed Assistant Secretary-General and Controller of the United Nations (UN) in New York, where he was in charge of the budgetary and financial operations of the UN.

Between 1997 and 2000, Mr Takasu served his country as Ambassador to the United Nations, representing Japan in the Security Council from 1997 to 1998. In early 2000, he was appointed Director-General of the Multilateral Cooperation Department in Tokyo, and subsequently, Ambassador in charge of civil society. ■



H. E. YORIKO KAWAGUCHI, FOREIGN MINISTER OF JAPAN, STATEMENT AT THE CONFERENCE ON FACILITATING THE ENTRY INTO FORCE OF THE CTBT, 3 SEPTEMBER 2003

"Since Japan is the only country in the world to have suffered the tragedy of atomic bombings, we Japanese people have a particularly strong desire for a ban on nuclear testing. ... Our efforts toward the early entry into force of the CTBT have permeated international opinion and the norm has taken root that all types of nuclear tests should be banned. Thus, the CTBT, even before entering into force, is playing an important role as a strong deterrent against nuclear testing. It is important that we ceaselessly and tenaciously persevere in our efforts."

Commission update

Report on the November 2003 Session

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization held its Twenty-First Session from 10 to 13 November 2003 in Vienna under the chairmanship of Ambassador Thomas Stelzer of Austria. 84 Member States attended the session.

The report of the Executive Secretary

Mr. Wolfgang Hoffmann, Executive Secretary of the CTBTO Preparatory Commission, reported in detail on the progress achieved in the implementation of all Major Programmes of the Preparatory Commission. He informed on such events as the International Monitoring System (IMS) Technical Training Programme, the training course for National Data Centre managers, the On-Site Inspection (OSI) table top exercise, the OSI experimental advanced course, the Global Communications Infrastructure/Evaluation joint workshop and the Information Visit Programme. Mr. Hoffmann reported that 68 out of the 337 IMS facilities have now been certified as fully meeting the stringent technical requirements of the system.

The Executive Secretary pointed out that the overall planning and implementation of work programmes became difficult due to currency fluctuations and the uncertainties about payments of 2003 contributions by Member States. He informed Member States that the Provisional Technical Secretariat (PTS) would initiate an internal review of the PTS with a view to further increase its efficiency.

The plenary debate

The main focus of the plenary debate was on budgetary issues and on the introduction of a split currency system to protect the Commission from the adverse effects of currency fluctuations between US dollars and euros. When expressing their views on the 2004 Programme and Budget proposals, several delegations stated that the nominal growth of 6,4% is high compared with the 2003 budget. Other delegations supported the PTS draft budget proposal as a good basis for further discussions.

Member States welcomed the signing of the Comprehensive Nuclear-Test-Ban Treaty by Afghanistan, Eritrea and Palau and the ratifications by Afghanistan, Algeria, Cyprus, Eritrea, Honduras and Kyrgyzstan since the last session of the Commission. Many delegations mentioned the successful outcome of the 2003 Conference on Facilitating the Entry into Force of the CTBT and encouraged the PTS to continue its outreach activities and to carry on holding training courses, seminars and workshops.

Conclusions

The Commission approved the budget for 2004 amounting to US\$94 548 700. It was decided to implement a split currency appropriation and assessment system starting with the 2005 Programme and Budget. Ambassador Yukio Takasu of Japan was elected as the next chairperson of the Commission for 2004. The contract of the Executive Secretary was extended until 31 July 2005. ■

Chairperson of the Preparatory Commission



Ambassador Thomas Stelzer, Permanent Representative of Austria to the CTBTO Preparatory Commission, has served as

Chairman of the Commission for the second half of 2003.

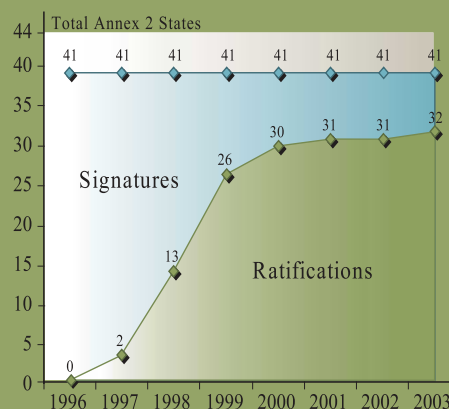
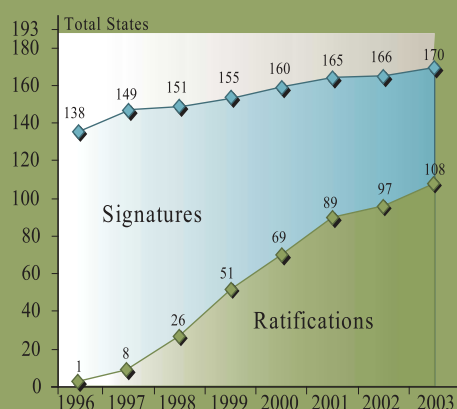
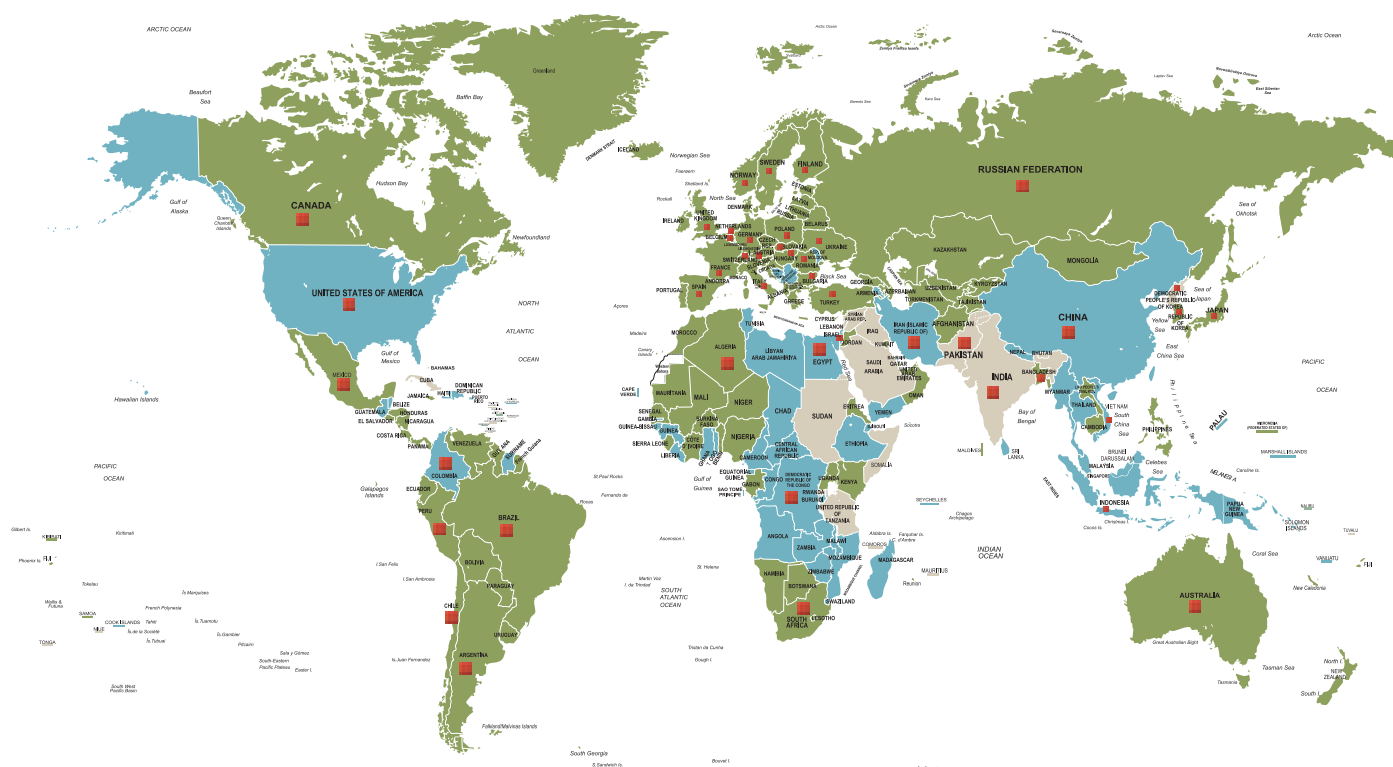
Ambassador Stelzer studied at the Faculty of Law of the University of Vienna, Austria, where he attained a doctoral degree. He also holds a diploma from the School for Advanced International Studies of the Johns Hopkins University and an M.A. in Latin American Studies from Stanford University.

Ambassador Stelzer joined the diplomatic service in 1988. From 1990 to 1995 he served as Minister Counsellor in the Austrian Mission to the United Nations in New York. In this position he served, *inter alia*, as Vice-Chairman of the First Committee. From 1995 to 1997 he worked as Deputy Director of the Austrian Cultural Institute in New York. Before he took up his current post in 2001, he held a post in the Provisional Technical Secretariat as Special Assistant to the Executive Secretary. ■

Treaty signatures and ratifications

STATUS AS OF 11 NOVEMBER 2003

	SIGNATORY STATES	RATIFYING STATES	NON-SIGNATORY STATES
	170	108	23
44 STATES LISTED IN ANNEX 2 TO THE TREATY	41	32	3



Between 13 November 2001, the opening of the 2001 Article XIV Conference, and 5 September 2003, the conclusion of the 2003 Article XIV Conference, 17 States ratified and seven States signed the Comprehensive Nuclear-Test-Ban Treaty, including one State listed in Annex 2 to the Treaty. The States that have ratified are Albania, Algeria, Botswana, Burkina Faso, Cote d'Ivoire, Cyprus, Georgia, Jamaica, Kazakhstan, Kuwait, Latvia, Mauritania, Niger, Oman, Samoa, San Marino and Venezuela. The States that have signed are Belize, Botswana, Cameroon, Central African Republic, Gambia and Libya. Since then one additional State signed (Afghanistan) the CTBT and four ratified it (Afghanistan, Eritrea, Honduras and Kyrgyzstan).

Secretariat snapshots

2003 Provisional Technical Secretariat Exhibition “CTBT: A Global Verification Regime”



“CTBT: A GLOBAL VERIFICATION REGIME”, PTS EXHIBITION AT THE 2003 ARTICLE XIV CONFERENCE

Participants at the 2003 Article XIV conference could see the CTBT verification technologies in operation at an exhibition in the foyer of the conference area. The exhibition, titled ‘CTBT: A Global Verification Regime’, focused on the technologies used by the International Monitoring System, the Global Communications Infrastructure, the International Data Centre and On-Site Inspections. Technical staff gave demonstrations of how the specialized verification equipment works.

Conference participants were shown how seismic signals travel via the satellite-based Global Communications Infrastructure, and had the opportunity to create seismic signals of their own which were displayed seconds later on a neighbouring monitor. Other exhibits included hydroacoustic cables, working infrasound elements, radionuclide station components and seismometers. A networked IDC workstation displayed



THE FOREIGN MINISTER OF FINLAND, MR ERKKI TUOMIOJA (LEFT), AND MR WOLFGANG HOFFMANN, EXECUTIVE SECRETARY, CTBTO PREPARATORY COMMISSION, AT THE OPENING OF THE EXHIBITION

near real-time seismo-acoustic data, and an extensive display of on-site inspection equipment was set up for participants to examine.

An exhibition of photographs of IMS facilities worldwide provided a

glimpse of the global reach of the IMS, the range of site locations and the diversity of station types. The exhibition is designed to be reusable, and was also on display during the 21st session of the Preparatory Commission in November 2003. ■



“CTBT: A GLOBAL VERIFICATION REGIME”, PTS EXHIBITION AT THE 2003 ARTICLE XIV CONFERENCE

Outreach activities

The PTS conducts a variety of activities focusing on enhancing the Treaty understanding of decision-makers and the general public, generating political support, encouraging international cooperation and building national technical capacities through training.

External relations

The Preparatory Commission attaches great importance to Africa's role in ensuring the entry into force and universality of the Comprehensive Nuclear-Test-Ban Treaty. It was the first geographical region visited by the Executive Secretary in 1997 and many missions have been undertaken since by staff from the PTS.

In 2002 and 2003, two African States signed and six ratified the CTBT, including one Annex 2 State. The CTBT is in line with African non-proliferation and disarmament initiatives such as the Declaration on the Denuclearization of Africa (1964) and the Treaty of Pelindaba (1996) which establishes a nuclear-weapon free zone in Africa. In addition, all African countries are parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT).

The Commission of the African Union has expressed its support for the CTBT and for the Preparatory Commission's work. A brochure on 'Africa and the CTBT', which includes a section on the political and civil and scientific benefits of CTBT membership, has been published in Arabic, English and French. ■

International cooperation

Sopron, Hungary, was the location for an Experts' Discussion on the Civil and Scientific Applications of CTBT Verification Technologies, organized by the Provisional Technical Secretariat (PTS) and the Government of Hungary on 6 September 2003. The meeting was held as a follow-up to an experts' discussion on the same topic which took place in London in May 2002. Nine scientists from six States contributed presentations to the meeting. Observers from three States, the Permanent Mission of Hungary and NGO representatives also attended the event.



EXPERTS' DISCUSSION ON THE CIVIL AND SCIENTIFIC APPLICATIONS OF CTBT VERIFICATION TECHNOLOGIES, SOPRON (HUNGARY), 6 SEPTEMBER 2003

The experts' discussion reviewed and further explored potential civil and scientific applications of seismic and radionuclide CTBT verification technologies. Participants noted the fact that the CTBTO Preparatory Commission does not foresee use of data from the International Monitoring System (IMS) network or of data products from the International Data Centre beyond the purpose of the Treaty at the present time. Several experts, however, expressed their concern that if data and products are not made publicly accessible to them, the IMS network and its potential civil applications may ultimately become less relevant for the scientific community. ■

Training

Access to specialized training is one of the major benefits offered to Member States by all three verification Divisions of the Provisional Technical Secretariat.

The main objective of the technical training programme conducted by the International Monitoring System (IMS) Division is to support the installation, operation and maintenance of the IMS network stations. Station operators, either managers or local operators of newly or soon to be installed stations, are invited to attend a two week training programme. The most recent training took place from 7 to 17 October 2003 in Austria. Twenty-six station operators from 19 States Signatories participated.

The first week consists of a general training for operators of all types of stations. In the second week, specific training courses for each technology and type of equipment are offered. In addition, equipment providers and installers provide local operators with on-site training during or shortly after the installation period. Training curricula are developed in close cooperation with station operators.



SEISMIC STATION OPERATORS VISIT THE CONRAD OBSERVATORY IN TRAFELBERG (AUSTRIA) DURING A TECHNICAL TRAINING PROGRAMME, 17-21 MARCH 2003

For more information on PTS training courses, please visit the CTBTO public web site: www.ctbto.org. ■

In the spotlight

Federal Minister of Foreign Affairs of Austria, H.E. Benita Ferrero-Waldner

Q: *One hundred and two States Signatories and five other States participated in the 2003 Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty (Article XIV Conference) in Vienna on 3-5 September. The Conference reaffirmed the international community's strong support for the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and its essential role in strengthening global peace and security.*

ratifications has steadily increased. In this respect, I was very pleased to note the ratification by Algeria in July, 2003 which was the first ratification by an Annex 2 State since February 2001.

Q: *Many participants during the Conference expressed fears that further delay in the CTBT's entry into force could lead to a resumption of nuclear testing.*

How do you see the prospects of early entry into force of the CTBT in the context of the steps outlined in the Article XIV Conference Final Declaration?

A: In the Final Declaration we reaffirmed our strong determination to undertake all measures consistent with international law to accelerate the ratification process in order to facilitate the early entry into force of the Treaty. The practical steps foreseen in the Final Declaration contain all conceivable elements to gradually increase the number of signatures and ratifications. Looking at the prospects of the entry into force of the CTBT, we should bear in mind that in the field of disarmament, arms control and non-proliferation it

that already 107 States have ratified the Treaty gives rise to optimism. Among those who have not ratified or signed the CTBT, there are some who face technical and logistic problems and others who still harbour doubts about the political merits of the Treaty. With regard to the first group of States, we must facilitate technical and legal assistance through the inter-sessional Coordinator, the Provisional Technical Secretariat (PTS) or the Special Representative, if appointed by ratifying States, to promote the ratification process. As regards the other States, we need to increase our efforts to raise awareness of the importance of the CTBT and use bilateral meetings, multilateral fora and various outreach activities to this end. This is a difficult task, but I am convinced that if we continue to join forces, we will succeed in bringing the CTBT into force.

Q: *Much attention at the 2003 Article XIV Conference focused on the various forms of benefits of the CTBT.*

In your view, what are the main political benefits of joining the CTBT?

A: In my view, the 2003 Article XIV Conference has been very successful. The participation of 107 States, including many on ministerial level, 70 of which delivered a statement in the general debate, bore witness to the high importance many States continue to attach to the CTBT and its entry into force. Delegations left no doubt about their unwavering commitment to the Treaty and made clear that the CTBT contributes significantly to nuclear non-proliferation and nuclear disarmament. Furthermore, as in 1999 and 2001, a number of countries have accelerated their ratification processes. As a result, the number of signatures and

“Looking at the prospects of the entry into force of the CTBT, we should bear in mind that in the field of disarmament, arms control and non-proliferation it normally takes many years until international treaties are accepted by a significant number of countries.”

normally takes many years until international treaties are accepted by a significant number of countries. The fact

A: In the past months, the issue of proliferation of weapons of mass destruction, in particular of nuclear



H.E. BENITA FERRERO-WALDNER, AUSTRIAN FOREIGN MINISTER, ADDRESSES THE 2003 ARTICLE XIV CONFERENCE, 3 SEPTEMBER 2003

In your view, what are the main political achievements of the Conference?



“The CTBT, which bans all nuclear explosions for civil and military purposes, is an essential element on the long way towards a nuclear-weapon free world which will make this planet much safer than it is now.”

weapons, has gained enormous importance and ranks high on the international agenda. The CTBT, which bans all nuclear explosions for civil and military purposes, is an essential element on the long way towards a nuclear-weapon free world which will make this planet much safer than it is now. The CTBT curbs the qualitative nuclear arms race, builds confidence and enhances international peace and security. As it was highlighted in a seminar held at the margins of the 2003 Article XIV Conference, the verification system of the CTBT also offers numerous benefits for civil and scientific applications, especially in the areas of environment and earth science.

Q: *In your speech at the opening of the 2003 Article XIV Conference you were encouraging delegates “to work towards a world that finally does not need any more Conferences on Facilitating the Entry into Force of the CTBT.”*

How does Austria, as the host country, regard its role in supporting moves towards entry into force of the Comprehensive Nuclear-Test-Ban Treaty?

A: Let me take this opportunity to reiterate that, while we follow impatiently the ratification process, we commend the CTBTO Preparatory Commission and the PTS for the excellent work they are doing in

achieving the entry into force of the Treaty and in setting up the international verification system. In my many bilateral and multilateral contacts, I regularly raise, where feasible and applicable,

the issue of CTBT signature and ratification. I have also instructed our Ambassadors and other senior officials in my Ministry to do likewise on their level. In the NPT process, Austria stresses the strong link between the NPT and the CTBT, as testified by the inclusion of the early entry into force of the CTBT into the 13 practical steps for systematic and progressive efforts to implement nuclear disarmament contained in the Final Document of the 2000 NPT Review Conference. At the 2003 Article XIV Conference, Austria supported the suggestion of establishing

a trust fund to finance inter-sessional activities promoting the early entry into force of the Treaty. In order to give the trust fund a good start, and as an incentive for other possible donors, Austria pledged the amount of € 10.000 to the fund which ratifying States will consider to establish. ■

Biographical note



H.E. Benita Ferrero-Waldner is the Federal Minister for Foreign Affairs of Austria. Ms Ferrero-Waldner holds a doctoral degree in law from the University of Salzburg. She joined the diplomatic service in 1984.

Besides working in various departments at the Foreign Ministry in Vienna, Ms Ferrero-Waldner also served between 1986 and 1993 as First Secretary at the Austrian Mission in Senegal and as Counsellor for Economic Affairs and Deputy Chief of the Austrian Mission in France. In 1994, she was appointed Chief of Protocol in the Executive Office of the United Nations Secretary General. In May 1995 she took up her assignment as State Secretary for Foreign Affairs in the Austrian government. She has held the position of Federal Minister for Foreign Affairs since February 2000. ■

“In my many bilateral and multilateral contacts, I regularly raise, where feasible and applicable, the issue of CTBT signature and ratification. I have also instructed our Ambassadors and other senior officials in my Ministry to do likewise on their level.”

Can CTBT infrasound technology assist civil aviation?

by Dr Hein Haak

In addition to their primary purpose of verifying compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the data of the verification technologies of the International Monitoring System (IMS) and the products of the International Data Centre (IDC) have the potential to provide a

is transported by winds, often in gigantic ash plumes.

Volcanic ash plumes can have a catastrophic effect on the jet engines of an airplane, causing them to malfunction or to stall completely. Volcanic ash melts at approximately 1100 °C. The operating

temperature of a jet engine is much higher – around 1400 °C – which is why hot material fuses to parts of the jet engine. Since 1982, a ‘flame out’ caused by the ingestion of volcanic ash into a jet engine has

happened four times. Airlines are keenly aware of the danger posed by volcanic ash, and have to be informed of any volcanic activity in the world. If volcanic activity is reported, airplanes must be rerouted. This safety measure has economic implications and can cause delays.

Efforts are underway currently to coordinate the reporting of volcanic activity around the world. The International Civil Aviation Organization (ICAO) of the United Nations, together with the World Meteorological Organization (WMO), the International Union of Geodesy and Geophysics (IUGG) and the World Organization of Volcano Observatories (WOVO), coordinate a programme called International Airways Volcanic Watch (IAVW). IAVW collects the data of ground-based measuring networks, satellite detection systems and in-flight air reports and it provides the necessary warnings to aircrafts.

How can infrasound help in the detection of volcanic eruptions? When a

“Volcanic ash plumes can have a catastrophic effect on the jet engines of an airplane, causing them to malfunction or to stall completely.”

range of useful civil and scientific applications. For example, the IMS infrasound network can detect volcanic events, and possibly make a contribution to air safety.

Today there are over 600 active volcanoes in the world. The Indonesian archipelago alone has over 100. Between 50 and 70 volcanoes are active during any given year and sometimes they can erupt violently. Recent examples include Mount Etna on Sicily in 2001, Montserrat in the Caribbean in 1995-1996, Pinatubo in the Philippines in 1991 and Mount St Helens in the United States in 1980. When volcanoes explode, tonnes of solid material can be thrown into the air. The lighter material



EXPLOSION, MOUNT ETNA (ITALY), JULY 2001



ASH PLUME CAUSED BY ERUPTION OF MOUNT ETNA (ITALY), 24 JULY 2001, 9:52 GMT

volcano explodes, it causes very low frequency infrasonic waves. These sound waves can propagate over thousands of kilometres. The explosions of Mt. Etna in July 2001, for example, were recorded in Europe at the IMS infrasound array IS 26 in Germany, in France near Flers and at an experimental infrasound array in the Netherlands at a distance of 1700 kilometres from Mt. Etna. The Dutch array recorded almost 1000 detections from Etna in less than a day. Infrasound arrays of the IMS network and also national institutions could, in principle, contribute significantly to the work of IAVW. The ICAO has already requested the CTBTO to study the possibilities of using the IMS infrasound network for the detection of volcanic events.

The detection and identification of nuclear explosions is not that much different from the detection of volcanic

“When a volcano explodes, it causes very low frequency infrasonic waves. These sound waves can propagate over thousands of kilometres.”



explosions. Volcanic explosions may occur in a series of quite small events, and they occur naturally at the surface of the earth. Other than this, there are strong similarities between the two types of explosive sources. Both also produce seismic and hydroacoustic

easily identified, such as the infrasound from interacting ocean waves, or infrasound that is caused by strong winds passing mountain ridges. With respect to explosive sources, identification is less certain. To distinguish between an exploding meteorite, a volcanic explosion

“Infrasound analysis is still in its infancy and the number of infrasound experts around the world is limited. At the moment, only a few phenomena are easily identified, such as the infrasound from interacting ocean waves, or infrasound that is caused by strong winds passing mountain ridges.”

signals which can be used in synergy with the infrasound measurements to detect explosions.

As well as locating infrasonic events it is also important that signals can be recognized and attributed to specific

or a nuclear explosion is still an unresolved problem. This problem becomes even more difficult to solve if the signals are small. In the learning phase of infrasound analysis other techniques are needed to make positive source identification.

“Further research and testing is needed to understand fully the potentials and limitations of monitoring volcanoes with infrasound.”

sources. Infrasound analysis is still in its infancy and the number of infrasound experts around the world is limited. At the moment, only a few phenomena are

What does this mean for the detection capability of volcanic events by the IMS infrasound network? Further research and testing is needed to understand fully the potentials and limitations of monitoring volcanoes with infrasound. However, in synergy with IMS and IDC data from the seismic and hydroacoustic network, infrasound is likely to become a viable technology to detect and locate volcanic events. ■

Biographical note



Hein Haak heads the Division of Seismology at the Royal Netherlands Meteorological Institute. In 1987 he joined the Group of Scientific Experts that laid out the

scientific basis for the CTBT. As a seismologist, he became also interested in the related field of infrasound, also of prime importance to the CTBT. In the decisive final year of the CTBT negotiations in Geneva, he served on the team that assisted the Dutch chair leading the negotiations. Since 1997 he has supported the work of the CTBTO Preparatory Commission as a Friend of the Chair of Working Group B. ■



DETAIL OF AN INFRASOUND ARRAY

Verification highlights

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) includes a definition of a global verification regime to monitor compliance with the Treaty. Establishing this regime, which must be capable of detecting nuclear explosions underground, in water and in the atmosphere, is the main activity of the Preparatory Commission for the CTBTO. The verification regime must be operational at the Treaty's entry into force. The regime consists of an International Monitoring System (IMS) supported by an International Data Centre (IDC), consultation and clarification, on-site inspections (OSI) and confidence-building measures.

85 facilities are currently sending data to the International Data Centre in Vienna, where the data is processed and released to Member States for final analysis. ■

IMS station operation and maintenance

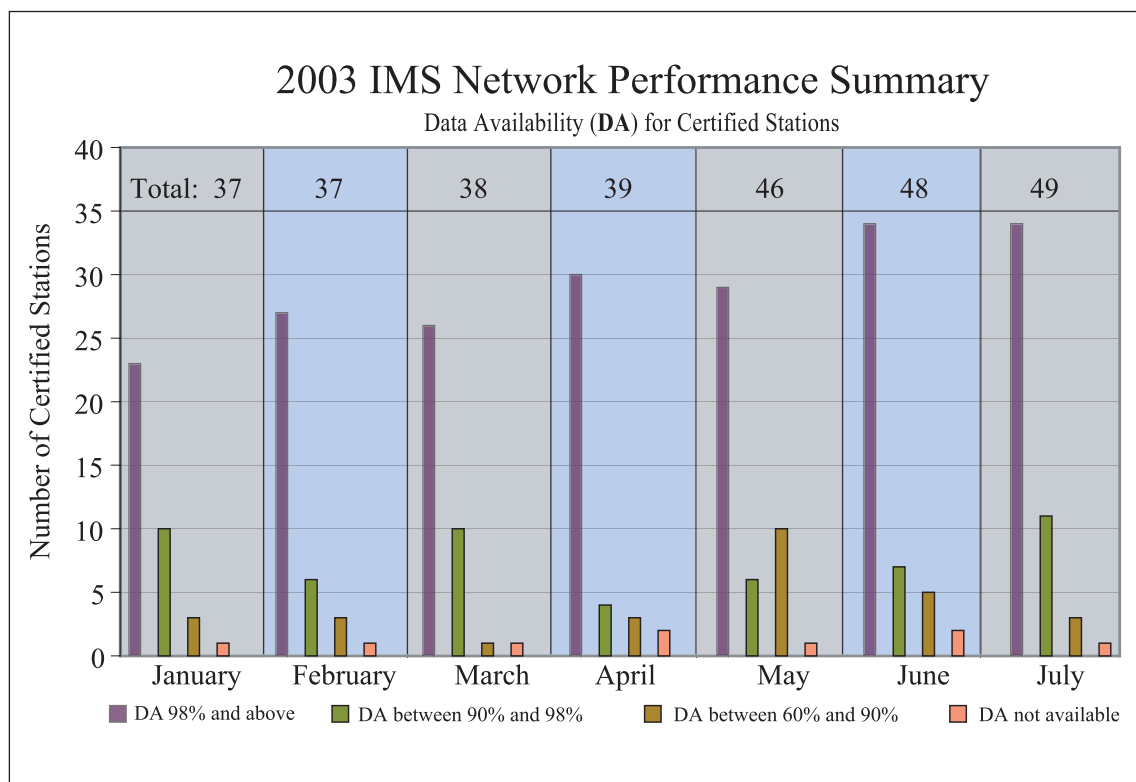
With approximately 50% of the International Monitoring System network of four verification technologies now constructed, the Provisional Technical Secretariat (PTS) is increasingly focusing on the operation and maintenance (O&M) of the IMS network. O&M will become the dominant part of the IMS programme once the stations are fully established.

An O&M coordination group was created to establish common O&M procedures and to promote a horizontal flow of information within the PTS. It reports to the Director of the IMS Division. The coordination of O&M includes activities such as the development of databases to manage information related to station O&M; coordination of the implementation of the model O&M contracts; the documentation of O&M procedures; the training of station operators and the development of logistical plans for the long-term sustainment of the network. To achieve this, O&M coordination is supported by the technical expertise of the IMS and International Data Centre Divisions, and representatives from the

IMS station status

Considerable progress has been made in establishing and certifying IMS stations in the past six months. The number of certified facilities meeting all technical specifications has increased from 57 to 68, including two radionuclide laboratories. Site surveys have been completed for 293 stations out of the 337 IMS facilities. Altogether 90 stations have already been established or substantially meet specifications, and 52 additional stations are under construction or in contract negotiation. Nearly 60 IMS stations are currently funded for operation and maintenance, either for testing and evaluation prior to certification or for post-certification activities. Some

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THE GRAPH DISPLAYS DATA AVAILABILITY (DA) FOR CERTIFIED STATIONS THAT HAVE STARTED OPERATIONS. DA IS A KEY PERFORMANCE INDICATOR (KPI) THAT REPRESENTS THE AMOUNT OF DATA RECEIVED AT THE INTERNATIONAL DATA CENTRE IN VIENNA. ON THIS GRAPH, DA IS EXPRESSED IN PERCENTAGES PER MONTH DIVIDED IN FOUR GROUPS (98% IS THE TARGET KPI SET BY THE PREPARATORY COMMISSION)



New approaches in GCI: Connecting remote stations to the IDC via private network circuits

Over the past twelve months, the Global Communications Section of the IDC has conducted a series of pilot tests to evaluate the suitability of Virtual Private Network



GLOBAL COMMUNICATIONS INFRASTRUCTURE NETWORK

(VPN) technologies for the transport of IMS data. The challenge was to find a

technology that had the same reach as the current satellite-based network and was as competitive in terms of cost and reliability. The Internet has been used as a medium to establish a VPN to the Provisional Technical Secretariat in locations with reliable Internet connectivity and where satellite-based services are unavailable due to either technical or commercial constraints.

Ten VPN connections using the Internet have been deployed so far. Special care has been taken to ensure full integration with the existing Global Communications Infrastructure information systems. The results of the pilot scheme to date have been very promising – in many cases the availability of the VPN services exceeds

that of traditional GCI technology. Deployment costs have also been lower. Future plans for VPN services include the integration of other remote office facilities with the Computer Infrastructure section.

Data sent via VPN is encrypted at a very high standard and future security projects are envisaged to enhance the security of VPN services connected to the PTS. Further VPN development is planned over the next twelve months in areas where traditional satellite-based technologies cannot be deployed. ■

Logistics are crucial to the effectiveness of an on-site inspection

Effective logistics are one of the key ingredients for a successful on-site inspection which will clarify whether or not a nuclear test explosion has taken place.

The 2002 On-Site Inspection Field Experiment (FE02) in Kazakhstan involved a number of operational activities such as overflight, passive seismometry, environmental sampling, visual observation, map-making and establishing a base camp. These activities, and the hundreds of 'actionable' lessons that emerged from FE02, would not have been possible without intensive prior logistical preparation.

Among the necessary arrangements was the travel of 27 inspectors from 18 different cities around the world to either

the Point of Entry in Almaty, Kazakhstan, or to Vienna and then to Almaty. More than two tonnes of medical, decontamination and inspection



MORE THAN TWO TONNES OF INSPECTION EQUIPMENT WERE SHIPPED FOR FE02

equipment had to be shipped from Vienna to Almaty and shepherded through customs. Two tonnes of potable water and batteries (for portable seismometers) were

purchased in Almaty to avoid costly air freight charges. In addition, in-country transportation needed to be arranged, including a 24 hour, 1200 km train and bus trip from Almaty to the remote Base Camp, six hours of helicopter time for overflight, and numerous vehicles to support in-field inspection activities. Accommodation, food service, laundry, etc. were contracted with a nearby coal mining company.

Although FE02 operations were conducted according to the Treaty's stringent timelines, the logistics were prepared in advance. FE02 provided a realistic laboratory in which the Provisional Technical Secretariat (PTS) could test and improve its logistics preparations for an eventual real OSI – when the PTS will have only six days to arrange such crucial services. ■

Verification science

The network of the International Monitoring System with its associated communications infrastructure and the International Data Centre was designed by a Group of Scientific Experts at the Conference on Disarmament in Geneva to be fully capable of monitoring compliance with the Treaty. New research and improved communications technology continuously strengthens and refines the detection capabilities of the IMS. This column introduces some of the latest developments in the field of verification science.

Testing high volume air samplers under severe environmental conditions

Of the four verification technologies used by the International Monitoring System, it is the radionuclide monitoring technology that provides definite proof that an event was of a nuclear origin. The radionuclide component of the IMS consists of 80 radionuclide particulate stations, 40 co-located noble gas stations and 16 radionuclide laboratories.

The operating principle of a radionuclide particulate station is straightforward. A large amount of air is passed through an air sampler – at least 500 m³/h over a period of 24 hours – and the particulate matter is collected on a filter. The filter is then measured with a high purity germanium detector to produce a gamma-ray spectrum. This allows the analysis of airborne radioactivity.

To ensure global coverage, some of the IMS radionuclide stations are located in very remote areas, where climatic conditions will have a considerable effect on operation. In particular, stations

located at high latitudes (the arctic and sub-arctic regions and Antarctica) may face a number of problems which could disrupt operation or damage the sampling system. For example, ice crystals may enter into the air sampling system during snowfall, in particular in conditions of drifting snow. Fog droplets may also enter the system and freeze inside the sampler. The air intake may clog up due to ice riming, high winds, or prevailing medium high winds.

To develop solutions to these problems, the Preparatory Commission is carrying out a number of studies on the behaviour of air samplers under severe, polar conditions. In 2002, a modified air sampler was tested in a climatic wind tunnel in Vienna, Austria, with the aim of identifying environmental conditions leading to ice riming on the air inlet and the subsequent clogging of the system, or to the entry of snow and ice particles into the system (Fig 1).



FIGURE 1: ICE RIMING DURING THE WIND TUNNEL TESTS IN VIENNA (AUSTRIA)

However, environmental parameters can be controlled within a wind tunnel, allowing somewhat predictable results, which is not the case under natural conditions. To test performance in these conditions, the

same air sampler utilised for the wind tunnel test has been installed at Sonnblick, around 50 km south of Salzburg, Austria, at an altitude of 3000m (Fig. 2). A series of tests are being



FIGURE 2: ICE RIMING UNDER NATURAL ENVIRONMENTAL CONDITIONS AT SONNBLICK (AUSTRIA)

carried out between March 2003 and May 2004. As was done in the wind tunnel tests, different inlet configurations are being tested as well. The goal of the tests is to develop implementable technical solutions to minimise the consequences of adverse weather conditions. But it will be possible to install air samplers which are likely to meet operational requirements at environmentally difficult polar stations only once the results of the study are available. ■

Potential civil and scientific applications

The International Monitoring System uses seismic, hydroacoustic, infrasound and radionuclide monitoring technologies capable of detecting evidence of nuclear explosions underground, in water and in the atmosphere in order to monitor compliance with the Comprehensive Nuclear-Test-Ban Treaty. These verification technologies, together with the data, technologies and products of the International Data Centre, have potential civil and scientific applications which can provide significant benefits to States and the international scientific community.

The CTBT radionuclide network: Detecting radiological events from a canvas of radionuclides

The establishment of the CTBT radionuclide network of 80 stations and 16 laboratories can be regarded as the development of a ‘machine’, comparable in scope to the



EQUIPMENT FOR FULLY AUTOMATIC SAMPLING AND ANALYSIS OF AIRBORNE RADIONUCLIDES, CTBT RADIONUCLIDE STATION SEP 63 IN STOCKHOLM (SWEDEN)

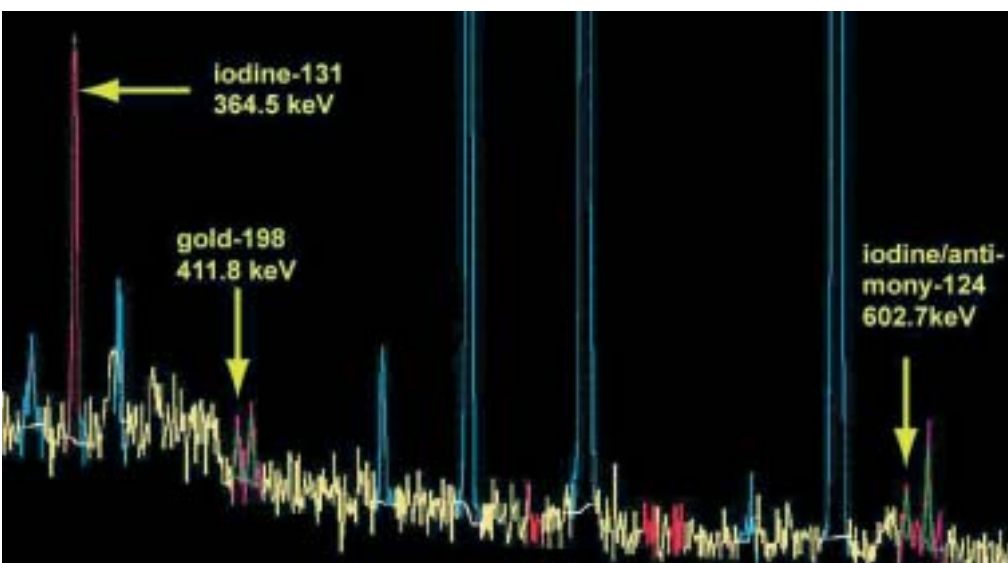
construction of a giant new particle accelerator for groundbreaking physics experiments, or some other enormous global project. Once established, the CTBT radionuclide network will have an unprecedented reach in terms of global and temporal coverage.

The radionuclide content in ambient air – the air that we breathe every day – is dominated by naturally occurring nuclides, be it radon daughters or cosmogenically produced nuclides like beryllium-7. CTBT-relevant radionuclides must therefore

be extracted from a background canvas of other radionuclides. These are also of interest for society and for our scientific knowledge. They provide information on humankind’s exposure to natural radioactivity in different environments on the globe, they can be used as tracers to validate atmospheric transport models and they can be used to study effects of cosmic radiation. Dust, pollen and insects on the filters can further provide a historic archive for a number of scientific studies.

In the 1950s, 60s, and 70s the global atmosphere always carried information on the atmospheric testing of nuclear weapons. One reason was that large nuclear explosions injected radioactive residues into the stratosphere, which in turn passed it down – in chunks delayed by years – to the troposphere we live in. The last atmospheric nuclear test was carried out in 1980 and by 1986 the stratospheric reservoir was nearly empty of any nuclides from this atmospheric test era.

While national institutions have in the past investigated radionuclides captured by small aerosol particles, new developments in noble gas (xenon) detection spearheaded by France, Russia, Sweden and the United States in cooperation with the Provisional Technical Secretariat will establish a technology, which, together with the particulate systems in the global network, will provide a unique detection capability. Automated and highly sensitive noble gas surveillance technology is actually a CTBT driven development that will surely also be of interest for other parts of society. ■



A SPECTRUM FROM THE CTBT RADIONUCLIDE NETWORK IN LATE 2002 WHICH SHOWS THREE ANTHROPOGENIC RADIONUCLIDES WHICH WERE MOST LIKELY PRODUCED FOR MEDICAL APPLICATIONS. THE UNMARKED PEAKS ARE NATURAL – FROM RADON DAUGHTERS AND FROM RADIONUCLIDES PRODUCED IN THE ATMOSPHERE OR IN THE DETECTOR BY COSMIC RADIATION. THESE NATURAL SIGNALS APPEAR IN ALL SPECTRA AND CONSTITUTE THE ‘FOREST’ WITHIN WHICH WE LOOK FOR NUCLEAR TEST EXPLOSIONS

Seminar on CTBT...

continued from page 3

Yoshio Fukao, a Japanese seismologist, underlined the advantages of linking global and regional networks in the field of seismic tomography, a technique of taking pictures of the earth's interior using seismic waves. Among other examples, he demonstrated the effect of atmospheric and oceanic loading, and seasonal variations thereof, on the earth's free oscillations. "We anticipate a great contribution of the CTBT network to understand the

phenomena involving the atmosphere, ocean and solid earth," he said.

Around 150 representatives of States, non-governmental organizations and the media participated in the seminar. ■

Operation and maintenance...

continued from page 12

Evaluation, Procurement, Financial and Legal Services Sections. O&M coordination consists of five functional areas: Operations, Engineering, Planning, Contract Management and Training. Operations is responsible for the development and implementation of common operational procedures, monitoring of station performance and evaluating operational, logistical and maintenance problems. Engineering and Planning develops an integrated network database to store and manage information relevant to IMS and Global Communications Infrastructure (GCI) station configuration management. The Contract Management group is in charge of managing O&M contract

implementation and finally, the Training Coordinator defines training programmes and oversees training workshops for station and site operators.

Except for the auxiliary seismic stations, which are operated with national funds, the PTS is expected to pay for the O&M once a station is certified. Operation and maintenance usually starts a few months before the station is certified, under testing and evaluation, to demonstrate that the station is performing well. Certification is therefore an important step for the host country, as a local technical institution will be engaged under contract with the PTS to operate and maintain the station. ■

Calendar of Meetings 2004

Preparatory Commission:

22nd Session 22 - 25 June 2004
23rd Session 15 - 19 November 2004

Working Group A:

25th Session 7 - 11 June 2004
26th Session 4 - 8 October 2004

Working Group B:

22nd Session 9 - 27 February 2004
23rd Session I 24 May - 4 June 2004
23rd Session II 30 August - 10 Sept. 2004

Advisory Group:

22nd Session I 19 - 23 April 2004
22nd Session II 17 - 21 May 2004
23rd Session 13 - 17 September 2004

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