A Treaty's Testing Times

The world's Nuclear-Test-Ban Treaty just turned ten.

Ola Dahlman ***looks at the record and the coming challenges.***

On 10 September 1996 the UN General Assembly adopted the Comprehensive Nuclear-Test-Ban Treaty (CTBT), prohibiting nuclear test explosions in all environments by all States. The Treaty is thus an essential element in the global nuclear non-proliferation regime.

Today, ten years later, 176 states have signed the treaty and 132 have ratified it. To enter into force, all the 44 States that possessed nuclear power or research reactors ten years ago must ratify the treaty and so far 34 have done so. As for the others—China, Colombia, Egypt, Iran, Indonesia, Israel and US—they have signed the treaty but not yet ratified it. India, North Korea and Pakistan have not signed.

It is disappointing that an important treaty that has been high on the international agenda ever since it was first introduced by the Indian Prime Minister Nehru in 1954, is still not in force. The fate of the treaty depends on political developments, especially in the key countries listed above. The treaty has, however, already established a global norm against nuclear testing, a norm that only India and Pakistan have broken.

Elaborate verification regime

The Preparatory Commission and its Provisional Technical Secretariat (PTS) were established in Vienna in 1996 to implement the treaty and to prepare for its entry into force. The Preparatory Commission has enjoyed a close cooperation among the States Signatories in implementing the treaty and its elaborate verification regime.

The key task for the PTS is to establish the verification arrangements specified in the treaty. The PTS has a staff of 300 people and a yearly budget of $100 million.

The treaty demands the most elaborate international verification regime ever created.

The assessment of compliance or non-compliance is a political process among the States. The verification regime provided by the treaty facilitates this process by giving all States a common base of information to use in their assessment. Individual treaty parties might have additional national technical means and additional capabilities of their own to analyze raw data.

The verification regime consists of two complementary parts; an International Monitoring System and an On-Site Inspection regime. In addition, there are provisions for consultations and clarification.

The International Monitoring System

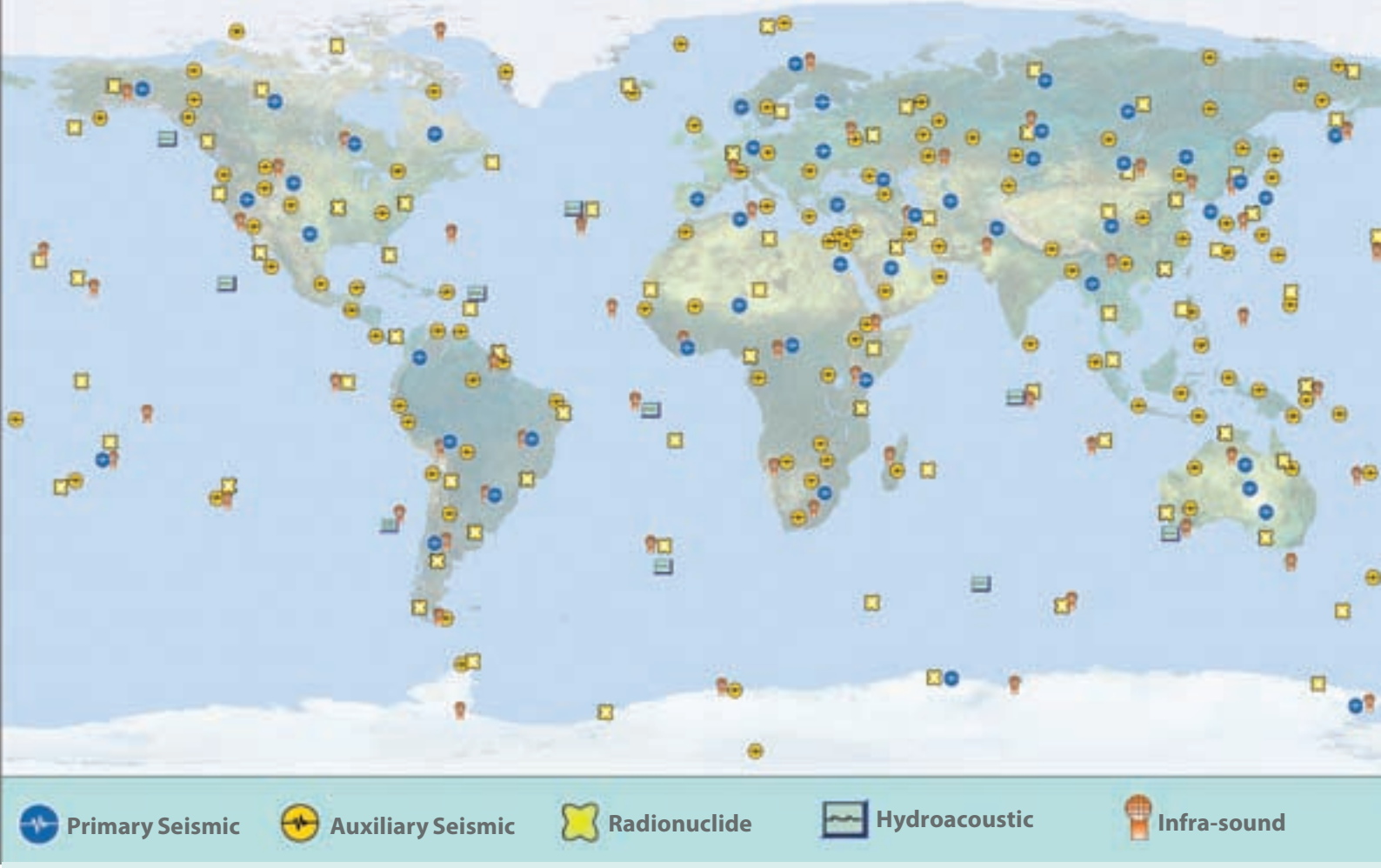
The International Monitoring System has a global reach with a total of 321 monitoring stations in 92 countries. It uses four different technologies to monitor all possible testing environments underground, in the oceans and in the atmosphere.

❶ The seismic network, consisting of 50 "primary" stations that report all data on line and 120 "auxiliary" stations from which data can be requested, is the main tool to monitor underground explosions.

❷ Only 11 hydro-acoustic stations are needed to monitor the oceans as signals in the water are transmitted with very little attenuation over global distances.

❸ A network of 60 infra-sound stations is designed to monitor explosions in the atmosphere. They detect acoustic signals with frequencies far below what the human ear can detect.

❹ The fourth component of the international monitoring system is the radionuclide network consisting of 80 stations to detect radioactive particles, 40 of which are also equipped to detect xenon, a radioactive noble gas. The pur-



More than 300 monitoring stations are set up in 92 countries under the nuclear-test-ban treaty.

pose of the radionuclide stations is to monitor the unique radioactive fallout that might emerge from a nuclear explosion in any environment. To analyze data from the radionuclide stations, 16 globally distributed laboratories constitute part of the system.

Data from the monitoring stations around the world are transmitted on-line to the international data center at the PTS in Vienna. Modern communications and computer technology make it possible to bring together and analyze the large amount of data created by monitoring stations.

At the data center, information from individual stations is analyzed together to detect and locate the source of the signal. This is a most complex process involving automatic signal processing and analysis by well-trained experts. States are provided with the results of this analysis as well as the raw data for their assessment.

On-site Inspection Regime

If, after consultations, a party is still concerned about another party's possible non-compliance, it may request an on-site inspection. The inspection request must be supported by at least 30 of the 51 members of the Executive Council to be set up after entry into force of the treaty. The requested inspection area can be as large as 1000 square kilometers. A number of intrusive tools can be used during an inspection ranging from over-flight observations, seismic and radioactive measurements to actual drilling.

Building the System

Building the monitoring system is a challenge in its own right, given its technical complexity and global reach. Building such a system in a political environment and in cooperation with 92 host countries with different legal systems, cultures and technical infrastructures makes the challenge even bigger.

The establishment of the system has proven more difficult and costly and taken more time than initially expected. Today two-thirds of the stations are completed and 170 stations are sending data to the PTS data center. According to the somewhat optimistic plans presented by the PTS, all but a few stations should be completed by the end of 2007.

The international data center has demonstrated that it is able to collect and handle large amounts of data. The focus so far has been on the analysis of seismic and radionuclide data. Routine reports of seismic events are being distributed to States.

All hands on deck as a crew installs a hydro-acoustic station in the ocean.

There is still a need to develop the analysis procedures to cover all technologies and to create an integrated bulletin. There is also a need to make the analysis procedures more efficient to cope with an increased data flow when all stations will be reporting data.

To specify the on-site inspection procedures in an operational manual has proven to be a difficult and politically sensitive task that is yet to be completed. It has been decided to carry out a large-scale trial inspection in 2008 to test methods and procedures using a special test manual. This test is expected to provide experience to finalize the preparation for the on-site inspection regime.

Under the treaty, the first conference of State parties must establish that an operational verification regime exists. This is a political decision based on an overall assessment of the verification facilities and procedures available at that time. Based on what has been achieved so far and on existing PTS plans, the international verification regime is, within a year or two, approaching the needed state of readiness for such a decision, should the treaty enter into force.

Coming Challenges

In the coming years, new challenges will be faced. The extensive verification regime is approaching completion while entry into force is not on the horizon: How will political interest be maintained? Will qualified persons in the activities of the PTS and at the many national monitoring facilities around the world be kept engaged?

Global capacity-building

To maintain and develop the CTBT as a global treaty is a question of capacity-building in States. We have so far successfully connected stations and instruments around the world. Now it is time to connect people and their institutions. Through international cooperation on a regional and

global scale, we have to develop the knowledge base and the facilities needed for States around the world to participate fully in the implementation and monitoring of the treaty. Such cooperation will also enable States to benefit from the technologies involved in the verification system and the data produced for civil and scientific applications.

Knowledge recapitalization

The global verification system is now in an important test and evaluation phase. This is likely to continue for an extended period of time and there are good technical reasons to do so. The global infra-sound, hydro-acoustic and radionuclide networks are unique and a lot of experience is to be gained on how to analyze and interpret the observations.

Establishing cost-efficient procedures for the analysis of a growing flow of data is crucial to the PTS and also at the top of the agenda of scientific institutions around the globe. A closer cooperation between the PTS and scientific institutions would thus be of great mutual benefit. Such knowledge recapitalization is essential to keep up the vitality of the organization and to make it attractive to new generations of experts.

Data for disaster mitigation

The International Monitoring System, designed and established for the sole purpose of verifying the treaty, provides, in many cases, unique observations that are also useful for disaster mitigation globally.

On an experimental basis, data is being provided to tsunami warning centers. Infra-sound data might prove useful in detecting volcanic eruption in remote areas to warn against ash-plumes, which pose a danger to air traffic. Infra-sound might also detect monster waves that could pose a threat to ocean-bound ships. The filters used to collect radionuclide particles also catch a lot of non-radioactive particles that might prove valuable in addressing global pollution issues.

States must find procedures for making data available for such humanitarian purposes. The radionuclide observations could provide information of great value for the non-proliferation regime as a whole. They are, however, the politically most sensitive ones to apply for non-CTBT purposes. (See "Sensing the Danger: Can Tsunami Early Warning Systems Benefit from Test Ban Monitoring," in the *IAEA Bulletin*, vol. 47-1, 2005.)

Looking Ahead

The CTBT has proven that it is possible to design, establish and provisionally operate a complex global monitoring system involving the cooperation of a large number of States. It has also been possible to agree on and implement the methods and procedures to be used for international analysis of collected data.

Infra-sound monitoring stations are established in a wide variety of environments — arctic, deserts and tropics.

Pictured here is a monitoring station in Diego Garcia, an atoll located in the heart of the Indian Ocean.

The design and testing of such a complex system takes a long time and can start well ahead of the political treaty negotiations. This was demonstrated by the Group of Scientific Experts at the Conference on Disarmament that paved the way for the CTBT.

Proposals have been made to establish a similar group of experts to address the verification of a cut-off treaty banning the production of weapon-grade nuclear material. Successful work on extensive and intrusive verification is in itself a confidence-building measure.

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