

**II International Conference on Non-Proliferation Problems****VERIFICATION METHODS FOR TREATIES LIMITING AND BANNING NUCLEAR TESTS**

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ОБ ОГРАНИЧЕНИИ И ЗАПРЕЩЕНИИ ЯДЕРНЫХ ИСПЫТАНИЙ**

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Treaty on limitation of underground nuclear weapon tests (TLUNWT) and treaty on world banning of nuclear tests (TWBNT) contribute to and accompany the process of nuclear disarmament.

Schematic process of nuclear test limitation and ban is in Fig. 1.

Test ban in three environments (Moscow treaty of 1963) as well as the Threshold Test Ban (TWBNT-1974) up to 1991 was controlled only with national means. But since 1991 nuclear test threshold of 150 kt has been measured with hydrodynamic and tele-seismic methods and checked by the inspection.

Distinctive feature of this control is that it's bilateral. This conforms to TLUNWT signed by two countries – USA and USSR.

Hydrodynamic method of measuring the explosion yield provides for location of sensors detecting strong shock wave of a nuclear explosion at the distances of several distance units ... several tens of meters from the center of explosion. Virtually it means that there are equipment and controllers directly at the place of fixing of nuclear device in the course of test preparation.

The inspection at the place of tests requires monitoring of the test site of the party conducting a test and geological information of rock in the area of explosion.

Only tele-seismic method if implemented without controllers at the place of a test.

Brief parameters of the three methods of control is in Table 1.

Table 1

TLUNWT VERIFICATION MEASURES

Method	Basic Characteristics
Hydrodynamic	<p><u>Standard arrangement:</u></p> <ul style="list-style-type: none"> <li>• Charge hole diameter is 4m;</li> <li>• Charge container diameter is no more than 3 m;</li> <li>• Charge container length is no more than 12 m;</li> <li>• Special requirements to packing, structure of the charge container, sensor locations etc.;</li> <li>• Additional hole is at the distance of 11-13m from the charge hole;</li> <li>• Detailed data on geology and shock wave properties of rock and core transfer;</li> <li>• The number of control personnel is no more than 35 persons.</li> </ul> <p><u>Non-standard arrangement:</u></p> <ul style="list-style-type: none"> <li>• instead of one additional hole there are three ones;</li> <li>• other peculiarities;</li> <li>• the number of control personnel is no more than 45.</li> </ul>
Tele-seismic	<p>For any test arrangements besides the national seismic net controlling party can locate seismic receivers at three indicated stations of the party controlled:</p> <p><u>USSR:</u> Arti (Sverdlovsk region), Novosibirsk, Obninsk (Kaluzhskiy region);</p> <p><u>USA:</u> Talsa (Oklahoma state), Black Hills (South Dakota state), Newport (Washington state)</p> <p>The number of the personnel is no more than 5 people at each station.</p>
Inspection at the place of a test conduction	<ul style="list-style-type: none"> <li>• Data on geology and physical and chemical rock parameters, core transfer.</li> <li>• Logging of the charge hole.</li> <li>• Observing the packing and the area around the test site.</li> <li>• Personnel number is no more than 23 people.</li> </ul>

Control measures of TLUNWT were applied in two nuclear tests of the USA at Nevada test site:

- in experiment "Hoya" (1991) inspection at the place of explosion was implemented;
- in experiment "Junction" (1992) hydrodynamic and tele-seismic methods of yield measuring were used.

## HISTORY & CURRENT STATE OF NON-PROLIFERATION PROBLEM

Coordinated schedules of control of the American experiment "Greenwater" and the Soviet tests "Batyr", "Guriya" and "Priliv" were not implemented due to these experiments cancellation.

In the Treaty of the World Nuclear Test Ban the following ways of international control are provided for:

- seismologic measurements;
- radionuclide measurements;
- hydro-acoustics measurements;
- infra-sound measurements;
- inspection at the place of tests conduction.

Control measures brief characteristics of TWBNT are in Table 2. It's clear that TWBNT protocol provides for rather a broad set of methods and technologies of control in all environments on all the territory of the Globe.

Not all the control measures are equal and have similar sensitivity. As it's well known TWBNT is a thresholdless treaty. This means that it's necessary to control a zero value of nuclear energy release. Unfortunately, experience shows that before TWBNT became valid there appeared facts of a non-complete registration of tests conducted by India and Pakistan.

Additional efforts of the World Community will be necessary for improving means and methods of control, optimization and their synergic application in order to guarantee observing the Treaty and to minimize inspections at the places of test conduction in future on the request of any TLUNWT State – member.

Table 2

TWBNT VERIFICATION MEASURES

Method	Basic Parameters
Tele-seismic	Global net of the primary (50) and additional (120) seismic stations.
Radionuclide	Radionuclide stations (only 80), including 40 stations capable of detecting radioactive inert gas.
Hydroacoustic	Hydro-acoustic stations: 6 of them are hydrophone; 5 of them are T-phase.
Infra-sound	Infra-sound station (60).
Inspection at the place of test conduction	<ul style="list-style-type: none"> <li>• The site area is no more than 1000 km<sup>2</sup>.</li> <li>• Linear size in any direction is no more than 50 km.</li> <li>• Durability is no more than 60 days (prolongation is no more than 70 days).</li> <li>• The number of inspectors is no more than 40 people (excluding the period of boring).</li> <li>• <i>Types of inspection:</i> <ul style="list-style-type: none"> <li>- aerial inspections;</li> <li>- visual inspections at the place of testing;</li> <li>- radioactivity measurements;</li> <li>- surface and near-surface sampling;</li> <li>- seismic monitoring of aftershocks;</li> <li>- resonance and active seismography;</li> <li>- magnetic, gravitation, radar and electric measurements;</li> <li>- boring and deep seated sampling.</li> </ul> </li> </ul>
Treaty organization and international monitoring system	<ul style="list-style-type: none"> <li>• TWBNT organization in Vienna.</li> <li>• International Data Center.</li> <li>• National Centers.</li> <li>• Global Communication System.</li> </ul>

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