



*Natural Resources  
Defense Council*

1350 New York Ave., N.W.  
Washington, DC 20005  
202 783-7800

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JOINT NUCLEAR TEST BAN VERIFICATION PROJECT  
OF THE SOVIET ACADEMY OF SCIENCES AND  
THE NATURAL RESOURCES DEFENSE COUNCIL

by

Thomas B. Cochran  
Natural Resources Defense Council, Inc.

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The United States government has sought a Comprehensive Test Ban Treaty (CTBT) since the mid-1950s - through every Administration from Eisenhower to Carter. From a U.S. perspective, at least up until the Reagan Administration, achieving adequate verification was the principal obstacle. Ultimately, negotiations toward a CTBT were broken off by the Carter Administration following the Soviet invasion of Afghanistan. Negotiations were not resumed during the Reagan Administration. Reagan is the only U.S. President to actively oppose a CTB.

General Secretary Gorbachev made clear his interest in a test ban when he unilaterally suspended Soviet testing in July 1985. He also announced that verification would not be an obstacle to a test ban. It is in this setting on May 28 of last year that the Natural Resources Defense Council (NRDC) and the Soviet Academy of Sciences agreed to establish and jointly man seismic monitoring stations adjacent to each of the principal nuclear weapons testing sites in the two countries: in eastern Kazakhstan in the Soviet Union and the Nevada Test Site in the United States. As you know, seismology provides the main tools for detecting and discriminating underground nuclear tests and for accurate estimates of their yields. The objectives of the project as originally envisioned are:

- to demonstrate that in-country nuclear weapons test verification is not an obstacle to a comprehensive test ban (CTB) or a moratorium on testing;
- to demonstrate that scientists of the United States and the Soviet Union are prepared to cooperate to work toward a common goal of a CTB; and
- to obtain baseline seismic data that would be useful in designing and operating a seismic verification network.

We agreed that we need not wait until a treaty was negotiated but could place equipment in the field to demonstrate verification procedures and find out what problems might arise.

In the past year, NRDC and the Academy have made substantial progress in implementing the NRDC/Academy agreement. Soviet seismologists from the Institute of Physics of the Earth (IPE) and U.S. seismologists from the Scripps Institution of Oceanography and the University of Nevada, Reno, jointly established the first station at Karkaralinsk on July 9 of last year. By the end of August the Soviet and U.S. scientists had established three stations around the Kazakh test site about 200 kilometers distant. The stations were located at Karkaralinsk, Bayanaul and Karasu in the Kazakh Republic (Attachment 1).

In an effort to begin as quickly as possible, it was decided to equip the stations in two phases. The stations were initially equipped (Phase I) with short period surface seismometers and battery operated portable digital recorders. Most of this equipment was loaned by Scripps. Over the last ten months

rotating teams of two seismologists from Scripps and the University of Nevada have joined with their IPE counterparts in operating this Phase I equipment.

In late July, Scripps also began the procurement of over \$600,000 worth of state-of-the-art seismic and computer data recording equipment for Phase II. This included high frequency down-hole seismometers which had to be custom manufactured.

Construction of facilities to house the Phase II equipment were completed by the Soviets by early November 1986. The sites, at Karkaralinsk, Bayanaul and Karasu, are all located in granite massifs that rise several hundred meters above the surrounding Kazakh steppe. In order to reduce the surface noise, boreholes which would eventually house the high frequency seismometers, were drilled to depths of 70 to 100 meters, cased, and sealed. Wellhead vaults were set in the surrounding rock, just below the earth's surface. At each site a large trailer was situated approximately 300 meters from the vault to house recording instruments. One or two additional trailers at each site provide accommodations for Soviet and American personnel. High-voltage power lines were installed at each site, along with backup diesel generators.

During the past three months the Scripps/IPE teams installed and calibrated the Phase II instruments at the three Kazakh stations. The three stations are now fully operational.

The Soviet Union ended its nineteen-month unilateral testing moratorium on February 26, 1987. At the insistence of the Soviet Government, the Kazakh stations are required to be turned off for a short period surrounding each of their tests. A military official flies in to each station a few days prior to a test, and a protocol is followed to shut down and seal the instruments. The day after the test an official returns and the stations can be turned back on. During the first few tests thus far, this procedure has not worked well due to the difficulty of transporting our team to each of the stations to turn them back on. Since February 26, the stations have been down about 50 percent of the time. Provided we can reduce the delay in restarting our stations, the scientific objectives of the project should not be compromised by the inability to record Soviet tests. The primary purpose of the project is to demonstrate technology to verify the absence of clandestine, or unannounced, tests.

While operating, the Kazakh stations will continue to collect seismic data from U.S. nuclear tests in Nevada, teleseismic and regional earthquakes, and industrial explosions in the region, as well as background noise. Our best scientific results, associated with verification of test limitations or bans, will come from the analyses of these data.

The ambient ground noise level is being recorded and its frequency dependence measured. The noise levels obviously

control the magnitude of events that can be detected and the accuracy with which signals can be characterized by any given station configuration. The improvements in signal-to-noise ratios by using 100 meter borehole instruments will also be measured.

Analysis of regional earthquakes and explosions (out to 2000 km) can be used to study the source properties and transmission efficiencies of various seismic wave types, which are usually termed seismic "phases", in the Kazakh area and thereby reduce uncertainties in the quantitative description of seismic wave propagation characteristics. These studies will be particularly useful in reducing the uncertainties of important parameters of models used to estimate the capability of in-country seismic stations to verify a low threshold test ban treaty.

We have been delayed in establishing the Nevada station and our Soviet colleagues have been unable to man them due to successful efforts by the Reagan Administration to obstruct our joint research program. In September 1986 we invited five Soviet seismologists from IPE to come to the United States to assist in selecting locations for the three seismic monitoring stations around the Nevada Test Site (NTS). The Reagan Administration first delayed action on the visa request until after their scheduled departure and then placed restrictions on their visas. The Soviets were told that they would not be permitted to visit

the proposed sites without first going to the Nevada Test Site and witnessing a nuclear explosion and a demonstration of CORRTEX. CORRTEX, the acronym for "continuous reflectometry for radius versus time," is a device for indirectly measuring the yield of an explosion by measuring the speed of the shock wave in a narrow radial distance range at the edge of the hydrodynamic zone. For tamped explosions in the 75 to 150 kiloton range, this range is a few tens of meters away from the explosion source. President Reagan had previously invited the Soviet Government to send their experts to Nevada for such a demonstration in response to General Secretary Gorbachev's extension of the Soviet test moratorium last April. The Reagan Administration's strategy has been to deflect Congressional interest in a nuclear test ban or moratorium by insisting that the Soviets have probably violated the Threshold Test Ban Treaty and that better verification methods are required before the Treaty is ratified. The Reagan Administration wants the Soviets to agree that each side be permitted to measure, using the CORRTEX technique, the yield of all nuclear tests above 75 kilotons conducted by the other side. (CORRTEX does not work well at lower yields because the distance range for the measurement of the shock speed is too close to the source.)

The Soviet position is that while the CORRTEX method is useful for measuring the yield of one's own tests, it is not a practical method of monitoring the yields of tests by a second



party, since confidence in yield estimates would be low because of uncertainties in the reliability of information required to properly emplace the CORRTEX system and interpret the recorded data. Many U.S. experts in and out of government agree with this conclusion. CORRTEX appears to be unworkable under a scenario which assumes cheating. The Soviets, moreover, do not wish to establish the precedent of renegotiating a treaty which both countries have signed, as a precondition to ratification. The Soviets, rightfully I believe, also see CORRTEX as yet another attempt by Administration officials, who are actually opposed to arms control, to foster the impression of movement in discussions with the Soviet Union.

Presumably for all of these reasons, the Soviets have refused to permit the seismologists associated with the NRDC/Academy project to participate in a CORRTEX demonstration at the Nevada Test Site. Without visiting the test site the Soviet seismologists were permitted to stay in the U.S. only seven days. We were permitted to take them to Scripps in LaJolla, California, where the Scripps/IPE teams, relying on slides, rock samples and geologic maps, selected the three station sites around the Nevada Test Site. These stations are located at Nelson and Troy Canyon, Nevada and Deep Springs, California (Attachment 2).

In February, a team from the Seismological Laboratory at the University of Nevada, Reno established temporary short period surface seismometers at these three locations and began recording data. We invited three Soviet seismologists to the U.S. to work for two months with our seismologists at Scripps and the University of Nevada and to assist in the construction and installation of the Phase II stations. Again, the Reagan Administration placed the same restrictions on their visas. Their stay in the U.S. would be limited to seven days and they could not go to our stations in Nevada or California unless they first went to NTS and witnessed a test and a CORRTEX demonstration.

In an effort to break the visa impasse, the Soviet Academy of Sciences convened a workshop on Nuclear Test Yield Estimation in Moscow on February 12, 1987. This workshop was attended by over two dozen scientists from eight countries. Two methods of yield estimation were considered: the CORRTEX method and several new seismic techniques. Soviet experts from the Academy presented technical papers on CORRTEX. U.S. Government experts on CORRTEX from Los Alamos National Laboratory (LANL) and experts on seismic techniques from Lawrence Livermore National Laboratory (LLNL) were invited. They did not attend. Following the workshop the Soviet Academy telexed the U.S. weapons laboratories offering to continue the discussions to identify the best method that can be employed for yield estimation. The Los Alamos and

Livermore experts were asked whether they could participate in such a workshop and, if so, what would be a convenient time and place for a meeting. The laboratory officials did not respond to this invitation.

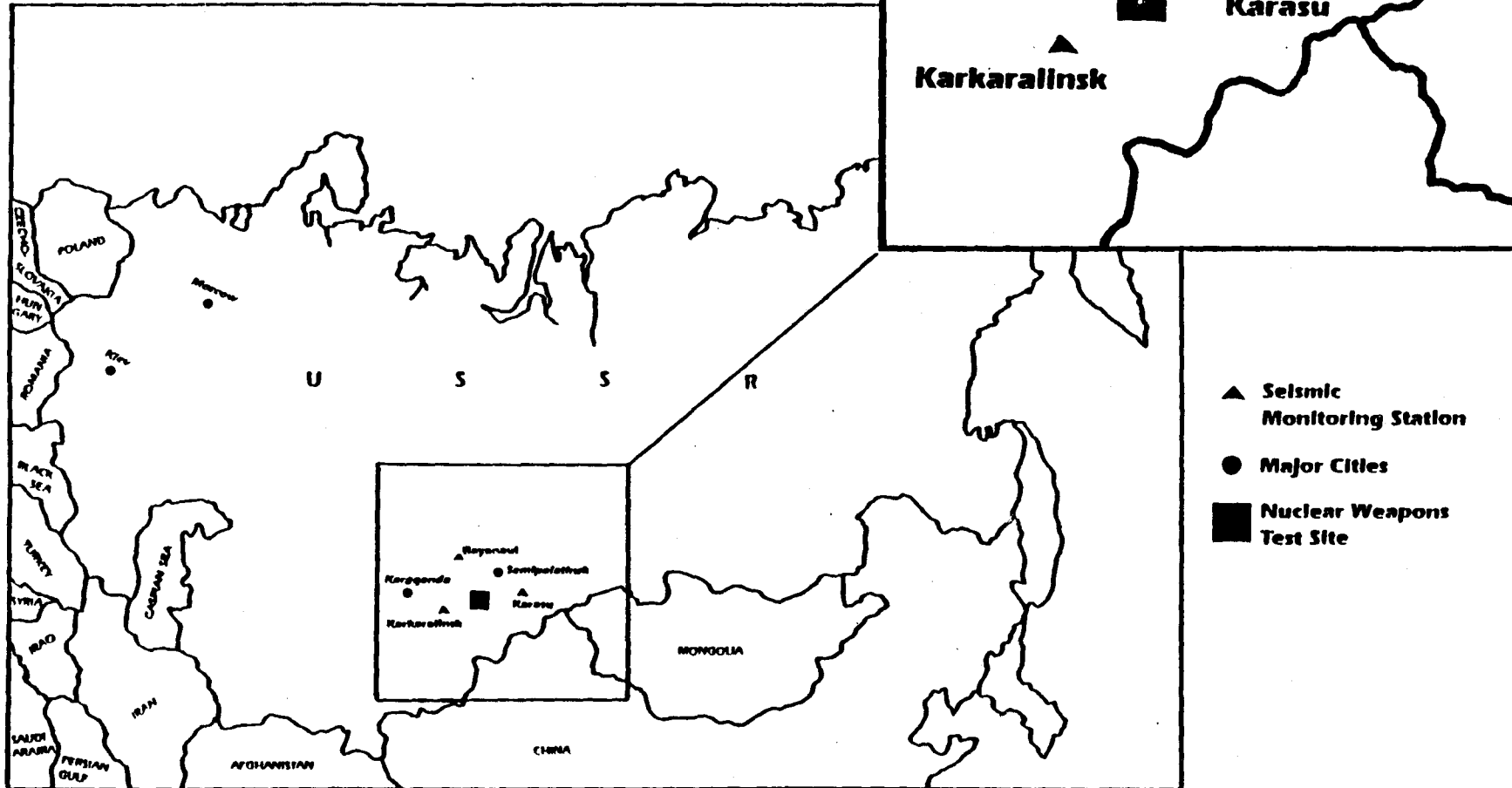
Despite these efforts by the Soviet Academy, the Reagan Administration continues to refuse to lift the visa restrictions of our Soviet colleagues. Ironically, at least for those of us from the United States, our first objective -- demonstrating that in-country nuclear weapons test verification is not an obstacle to a comprehensive test ban -- has been accomplished only in the Soviet Union. We have met fully our second objective -- demonstrating that United States and Soviet scientists are prepared to cooperate to work toward a common goal of a comprehensive test ban. With regard to our last objective -- obtaining valuable baseline seismic data useful for designing and operating a seismic verification network -- I hope that despite the operational difficulties placed on us by the two governments, we will be able to operate our Phase II instruments for a year. This will be decided next month.

We are determined not to let the Reagan Administration stymie our efforts to install and operate the three stations around the Nevada Test Site. We have begun drilling the bore hole at the Deep Springs station. This first station should be fully equipped by mid-June. All three U.S. stations should be fully operational by the end of the summer. The seismic data

collected at these three stations will be telemetered to Scripps in LaJolla, California. As a contingency, we plan to transmit the data from these three stations from Scripps to Moscow via satellite. If the Soviets cannot come to Nevada, we will take Nevada to the Soviets.

# NRDC/ ACADEMY OF SCIENCES, USSR

## Selsmic Monitoring Stations In the Soviet Union





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**Seismic  
Monitoring  
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in the  
United States**

