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JOINT CONTRIBUTION ON THE LESSONS LEARNED FROM THE FIRST UNITED STATES/RUSSIAN FEDERATION JOINT TABLETOP EXERCISE TO PREPARE FOR CONDUCTING ON-SITE INSPECTIONS UNDER THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY

Summary

A United States/Russian Federation Comprehensive Nuclear-Test-Ban Treaty on-site inspection joint tabletop exercise took place in Snezhinsk, Russia, from 19 to 24 October 1998, under the auspices of the bilateral CTBT Joint Working Group Three. The objectives of the exercise were to examine the functioning of an inspection team (IT) in a given scenario, to evaluate the strategies and techniques employed by the IT, to identify ambiguous interpretations of Treaty provisions that needed clarification, and to assess the overall utility of tabletop exercises to assist in developing an effective Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification regime.

To achieve these objectives, the United States and Russian Federation (RF) agreed that two scenarios would be conducted. The first would be developed by the RF, who would act as controller and as the inspected State Party (ISP), while the United States would play the role of the IT. The roles would be reversed in the second scenario; the United States would develop the scenario and play the ISP and act as the game controller, while the RF would play the IT. A joint exercise planning team, comprised of members of both the U.S. and Russian teams, agreed on ground rules for the two scenarios and established a joint evaluation team to evaluate the entire exercise.

To meet the limitations of the time available for the exercise, the scope needed to be limited. The joint exercise planning team decided that each of the two scenarios would not go beyond the first 25 days of an on-site inspection (OSI) and that the focus would be on examining the decision-making of the IT as it utilized the various activities and technologies to clarify whether a nuclear test explosion had taken place. Hence, issues such as logistics, restricted access, and activities prior to point of entry (POE) would be played only to the extent needed to provide for a reasonably realistic context for the exercise to focus on inspection procedures, sensor deployments, and data interpretation.

Each scenario began at the POE and proceeded with several iterations of negotiations between the IT and ISP, instrument deployments, and data evaluation by the IT. By the end of each scenario, each IT had located the site of an underground nuclear explosion (UNE). While this validated the methods employed by each IT, the evaluation team noted that each IT employed different search strategies and that each strategy had both advantages and disadvantages. The scenarios highlighted ambiguities in interpretation of Treaty provisions related to overflights. In addition, a substantial number of lessons were learned relating to radionuclide monitoring, the modeling of seismic background noise in tabletop exercises, the problems associated with conveying visual information efficiently and effectively, the impact of logistical constraints, and the modeling of these constraints on successful OSI execution. These lessons are discussed more fully in the body of this report.

Although the U.S. and Russian participants and the evaluation team agreed that the exercise had met its objectives, there were a variety of areas identified that could be improved in subsequent OSI exercises. Some of these included: reexamination of the methods used to convey visual observation data in an exercise; the amount of time compression employed; the increased application of logistical constraints on sensor deployment and other IT movements; and the need for better joint understanding and agreement pertaining to the structure, format, and other rules of the exercise. More time spent on joint planning of the exercise is recommended.

This report summarizes the lessons learned pertaining to both the technical and operational aspects of an OSI as well as to those pertaining to the planning and execution of an OSI exercise. It concludes with comments from the evaluation team and proposed next steps for future U.S./Russian interactions on CTBT OSIs.

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1. INTRODUCTION

1.1. Exercise Objectives

A United States/Russian Federation Comprehensive Nuclear-Test-Ban Treaty on-site inspection joint tabletop exercise took place in Snezhinsk, Russia, from 19 to 24 October 1998, under the auspices of the bilateral CTBT Joint Working Group Three. The objectives of the exercise were the following:

- To simulate the actions of an OSI inspection team (IT), including interactions with the inspected State Party (ISP), in order to examine different approaches to inspections and to develop appropriate recommendations for the international community.
- To identify ambiguities and contradictions in the interpretation of Treaty and Protocol provisions that might arise and become apparent in the course of an inspection and that need clarification in connection with the development of the OSI Operational Manual and on-site inspection (OSI) infrastructure.
- To evaluate the efficacy of using tabletop exercises to assist in developing an effective Comprehensive Nuclear Test-Ban Treaty (CTBT) verification regime.
- To identify strong and weak points in the preparation and implementation methods of such exercises for the purpose of further improving possible future exercises.

1.2. Exercise Implementation

To achieve these objectives, the United States (U.S.) and the Russian Federation (RF) agreed that rather than conducting one exercise with mixed teams, which would require a great deal of time to organize and plan, two scenarios would be conducted. The first would be developed by the RF, who would act as controller and the ISP, while the U.S. would play the role of the IT. The roles would be reversed in the second scenario, for which the U.S. would develop and play the ISP, while the RF would play the IT. Separate U.S. and Russian control teams developed each OSI scenario and planned and developed the exercise. Separate U.S. and Russian data teams developed data in advance of the exercises and generated the data during the actual exercises.

A joint exercise planning team, comprised of members of both the U.S. and Russian teams, agreed on a number of ground rules for the two scenarios and established a joint evaluation team to assess both of the scenarios against the stated objectives. This latter group was comprised of two people from the United States and two from the Russian Federation. Their task was to observe the functioning of all of the teams and their interactions and to lead the post-exercise discussion, commenting on the preparation and presentation of the data, the strategies employed by the teams in their roles as IT and ISP, and the utility of the exercise as a whole. The comments from the evaluation team can be found in a subsequent portion of this report.

To effectively examine the issues stated in the objectives, the scope of this joint exercise needed to be limited. The joint exercise planning team decided that each of the two scenarios should focus on the first 25 days of an OSI and that the emphasis should be on the decision-making process of the IT as it utilized the various inspection activities and technologies to clarify whether a nuclear explosion had taken place—i.e., where, how, and when the IT deployed its permitted sensors and conducted overflight and ground-based visual observation; how the IT evaluated the data received from those inspection activities; and how it then redeployed its inspection sensors and visual observation assets. Hence, issues such as logistics, restricted access, and activities prior to point of entry (POE) were played only to the extent needed to provide for a relatively realistic scenario and interaction among the teams.

In the discussions of the exercise given below, the reader will note that many of the details of the respective U.S. and Russian scenarios have been omitted. This has been done for two reasons. Firstly, both the Russian and U.S. participants agree that wherever possible, this report should not include information helpful to a possible violator of the CTBT, such as details of possible evasion strategies. Secondly, some details of the scenarios used in this exercise may be used in the future for additional bilateral or multilateral exercises and thus are best not publicly revealed. To this end, the attempt in this report has been to convey only enough detail to support the discussion of lessons learned.

2. SCENARIO DESCRIPTIONS AND SUMMARY OF PROCEEDINGS

2.1. Russian-Developed Scenario

State X, a party to the CTBT, requests clarification of a magnitude 4.0 event detected by the International Data Centre (IDC) on 3 October 1998 occurring in State Y. State X claims that the ratio of magnitudes of surface-to-body waves indicates a high probability that this event is of an explosive nature and, since the International Monitoring System (IMS) has never previously detected explosive activity at this level in this region of State Y, State X is concerned about possible CTBT noncompliance.

State Y responds that there was, indeed, an explosion on the date specified by State X, but that this was a chemical explosion carried out at an open-cast mine to test new cost-effective methods of crushing rock. Further, State Y claims that previous conventional explosions in this same quarry were detected by the IMS as magnitude 2.5 and 3.0 events, but these did not cause CTBT compliance concerns. Additionally, State Y states that no IMS radionuclide stations detected any evidence of noncompliance.

State X is not satisfied by this explanation, claiming that the data provided by State Y are inconsistent with those of a chemical explosion and elaborating on State Y's recent intensified efforts to develop its nuclear program. For these reasons, State X requests an on-site inspection of State Y. A copy of this consultation and clarification package can be found in Appendix I.

The play of this scenario, in which the United States acted as the IT, and the RF acted as the ISP, began with the POE briefing, which provided general information about the inspection area, the base camp, the aircraft available for the overflight, and other logistical support information. The U.S. IT began its inspection with an overflight of selected portions of the inspection area while setting up a base camp. The IT also planned routes for ground-based visual observations and deployed several seismic- and radionuclide-monitoring sensors, also in a targeted search of selected portions of the inspection area.

The U.S. IT initially concentrated on investigating the mines and the radiological waste storage site and interviewing the mine and waste site managers. Results of the visual observations at these areas were generally uninteresting, except for the radiological waste storage site, where Cerium-144 was also detected in a radiological swipe sample.

Initial seismic data results indicated 84 "event" detections on days three and four of the inspection. Of these, only one event involved detection by more than one station. When it became obvious that the seismic data included a lot of local noise in the data (such as heavy equipment or machinery operation, which would be detected only by a single station), the U.S. IT began to look solely for multiple-station detections to get "reliable" events. Eventually, the IT detected quite a few events consistently occurring near one particular portion of the inspection area and concentrated seismic stations there. From a plot of all the multiple-station events detected, the U.S. IT was able to pinpoint a hypocenter for the suspect event. Gas sampling was also done in this area and ^{37}Ar was detected in a gas sample taken on day 15.

2.2. U.S.-Developed Scenario

Atlantia, a party to the CTBT, requests clarification from Pacifica regarding an IMS-detected event on 1 November 1998. The event, a 3.6 magnitude seismic event, was detected at a depth of less than 5 km, and it occurred in an area of increased ambiguous activity, which included tunneling.

Pacifica responds that it was investigating the source of this event but believed it to have been caused by an unintentionally large chemical explosion at a commercial surface coal mine located in the vicinity of the reported event. Pacifica further stated that personnel at the mine had planned a ripple-fire explosion in the course of routine mining activity, but for unknown reasons, inadvertently all explosives detonated simultaneously. News reports of a 4.1 earthquake in the vicinity of the reported event are also furnished by Pacifica to provide another possible explanation for the IDC-reported event. Pacifica also draws attention to the fact that no other component of the IMS detected any evidence of noncompliance, including two radionuclide stations and one infrasound station, all within 500 km of the event.

Atlantia is not satisfied with this explanation, claiming that it is highly unusual that a chemical explosion in a surface mine could have caused a magnitude 3.6 event. Such an explosion would require a quantity of explosives far in excess of any known mining practices for the type of procedure claimed by Pacifica. Also, Atlantia claims that if this event had been caused by such a large chemical explosion, the infrasound station in the area would have detected it. For these reasons, Atlantia requests an on-site inspection of Pacifica to clarify whether a nuclear explosion had been carried out. A copy of this consultation and clarification package can be found in Appendix II.

When the IT arrived at the POE, they were briefed about the inspection area, the base camp, and the logistical support that they would be provided by the ISP. In their initial deployment, the Russian IT deployed 30 seismic stations on days two and three of the inspection, in a fixed 4-km grid, concentrating on the large central alluvial valley in the inspection area. The reason for this is that the aftershock rate decays most quickly in alluvium. The Russian IT immediately detected aftershocks from the underground nuclear test, but had difficulty interpreting the results because the coarse station coverage resulted in relatively poor event location determinations, especially depth. The Russian IT continued monitoring up to 21 days, when they detected the presence of ^{37}Ar in a gas sample taken from an area where the aftershocks were occurring.

3. OSI TECHNICAL AND OPERATIONAL LESSONS LEARNED

Each of the following sections provides a summary of the lessons that were learned as a result of the U.S./Russian joint tabletop exercise, as they relate to technical and operational OSI issues. Overflight activities are presented first, followed by ground-based visual observations, passive seismological monitoring, radionuclide monitoring, and logistics issues. The last section, OSI overall strategy lessons learned, describes the strategies employed by the U.S. and Russian teams as they simulated inspectors and members of the ISP.

3.1. Overflight Activities

The U.S./Russian joint tabletop exercise raised a variety of issues regarding the intent, utility, and proper conduct of an overflight. These issues, discussed below, specifically pertain to flight platforms, flight speed, extent of initial search, use of real-time dosimeters in flight, effects of varying terrain, and duration of flights. While the opinions of the observers and evaluators regarding the utility of the overflight varied greatly, it was clear that in both the Russian and U.S. scenarios, the overflight fulfilled a key mission—to narrow the inspection area.

Flight platform. This set of scenarios demonstrated the benefit of using a helicopter rather than fixed-wing aircraft for CTBT on-site inspections. Even in a full-grid search, as employed by the Russian IT, the helicopter had sufficient speed to examine the entire 1000 km^2 area and still allow for follow-on overflights, within the 12-hour limit. Additionally, the helicopter could hover, permitting close-in examination of areas either before a ground team arrived at a location or supplementing the ground-based visual observation when an area was not easily accessible by ground transportation.

Duration of flights. The duration of the overflights became an issue early in the tabletop exercise. The Treaty language is somewhat obscure on the issue of breaking the overflights into segments, using information from ground inspections to focus a future overflight on areas of interest. One evaluation team member remarked that no nation would permit the frequent use of brief overflights for many days or weeks, as the U.S. IT attempted to exercise. The intention of the Treaty writers, according to another evaluation team member, was to complete the overflight early in the inspection. Thus, while an IT might divide the allotted 12 hours into several flight segments, the IT should not depend upon access to the aircraft beyond the first two-to-three days, unless weather conditions, safety issues, or equipment availability interfere with the possibility of an early overflight.

Extent of initial search. Differences between U.S. and Russian IT overflight strategies were most clearly defined in the use of broad area searches by the Russians as compared to the searches initiated by the U.S. that focused on unusual aspects of the maps and data supplied by the ISP. In both scenarios, the main purposes of the aerial search were to become more familiar with the area (terrain, road access and condition, and ground transportation possibilities) and to locate areas where conduct of an underground nuclear explosion (UNE) could be ruled out. This strategy was intended to eliminate a large part of the map area for immediate consideration, i.e. narrowing the search area. The U.S. IT focused upon specific areas of interest, including places where there were unclear symbols on the map and preidentified cultural features, trusting that they had fairly complete maps, whereas the

Russian IT assumed that the maps were not complete and that some cultural features might be missing. Each approach has its merits and the scenarios did not indicate a clear superiority for either approach. It was noted that commercial satellite images (not used in this exercise) will most likely be available to a real IT that would show extensive road patterns and the larger facilities; however, overflight observations may still be crucial for finding disturbances that appear to be inconsistent with the surroundings and thus may be indicators of unusual activities.

Use of real-time dosimeters in flight. If use of a wide spectrum gamma counter were permitted in the overflight, this could make a broad search quite useful in attempting to identify radioactive sources over the inspection area. It was clear that both ITs in this exercise wished to use some sort of Geiger counter or low-resolution sodium iodide NaI(Tl) detector in the initial overflight. Even pocket-size ratemeters (or chirpers) were considered for this purpose.

Effect of varying terrain and weather. The terrain, vegetation, and time of year of an OSI will have a substantial impact upon the information that may be gathered during visual observations, both from the air and on the ground. The temperate wetlands used in the Russian scenario of this exercise could be muddy and difficult to maneuver in, and thick pine and birch forests could make many small roads difficult to see unless one is directly above them. Similarly, intense heat of summer conditions or snow at higher elevations in the desert environment used in the U.S. scenario could have a significant impact on IT activities and effectiveness.

Equipment and personnel on overflight. Of the permitted equipment, the still cameras and global positioning system locators appear to be the most important. Simulating the use of binocular views in the exercise was difficult, but binoculars would also prove quite valuable during an overflight (perhaps more so from a fixed-wing aircraft than from a vibrating helicopter). Use of video equipment raised a problem generated from having the ISP provide the photographer(s). If only one photographer is provided, then the IT could not record from two cameras at once, or from a still camera and a video camera. The IT will clearly need to negotiate this issue with the ISP. Whether there are two ISP photographers or one ISP and one IT photographer, more than one photographer riding along on the overflight would optimize the utility of photography during the overflight.

Flight speed. Aircraft speed became an issue during this tabletop exercise. The Russian side requested that speed not exceed 200 km/hr (~160 knots) air speed. From an optics perspective, this is reasonable because observations on the ground blur for close-in viewing as speed grows. Both eyeball observation and photographs lose resolution with increased speed. Speeds greater than approximately 150 knots force the use of unacceptably high shutter speeds with reduced along-track image resolution. Thus, helicopters or slow speed high-lift fixed-wing aircraft will be the aircraft of choice in an OSI.

Data synthesis. There were significant difficulties in efficiently and effectively presenting ground-based visual observation and overflight data. Such data are voluminous and complex and require a great deal of concentration by the IT and extensive preparation by the data teams. While some aspects of the presentation of visual observation data in the exercise could be streamlined, this difficulty is not unique to the exercise, but represents an accurate simulation of the difficulty in presenting such data to the IT during a real field OSI. Each day, teams of 10 to 20 people will return to base camp, reporting their observations to the other members of the IT. How will they perform this task in a real OSI so that everyone is aware of the observations of other team members? It will be a challenging task to integrate this information, as was demonstrated in the exercise. The technical training of the inspectors and their ability to focus on the unusual aspects of their observations will be key in the success of an inspection.

Additionally, it will be difficult to explain, via photographs alone, the distinguishing features that were seen either from the air or on the ground. The eye/brain combination is a far better tool than a two-dimensional photo. Consequently, rather than suggesting that the presentation of visual data should be improved for the exercises, a method ought to be developed instead to aid in synthesizing visual observation data with other forms of data collected during an OSI.

3.2. Ground-Based Visual Observations

Documentation of visual observations. While there were many lessons learned in the U.S./Russian joint tabletop exercise, one of the most pronounced was that an IT member will be mentally processing much more data directly observed than can effectively be conveyed during a simulation exercise, either verbally or with photos that are, of course, taken out of context. This emphasizes the subjective nature of visual observations and the necessity for inspectors to be well trained in the art of perception, interpretation, and communication. Visual observations will have to be particularly well documented to substantiate and integrate with the other OSI data.

Visual observation expertise on ITs. As with other specialized areas of expertise relevant to OSIs (e.g. field seismology), analysis of visual data in the context of an OSI requires a high level of skill and experience. For this exercise, both inspection teams included true experts capable of recognizing nuclear explosion-related visual clues. For a real OSI this high level of expertise may not be available, since not all potential inspectors will have experience with nuclear testing and may have less refined technical skills. A proper combination of expertise in radiology, seismology, geology, mining practice, nuclear testing, ground and airborne visual, logistics, as well as the CTBT Protocol, is essential to conduct a thorough inspection.

Interviews. During the course of an inspection, an IT may wish to interview people in and around the inspection area and have informal interactions with ISP representatives, as was demonstrated in both scenarios. While formal interviews may be very important, they may involve high-level ISP representatives who may not be knowledgeable enough to provide the details sought. Thus, the informal interactions that take place between the inspectors conducting a visual observation and their ISP escorts may provide the best information. But because interviewees are not always well versed in either Treaty provisions or specific sensitivities at their site, they may inadvertently provide sensitive information that is unrelated to the purpose of the inspection. It is important, therefore, to strike a proper balance in granting inspectors the privilege of interviewing personnel in and around an inspection site, while protecting sensitive information.

3.3. Passive Seismological Monitoring

The objective of passive seismic monitoring during an OSI is to detect small-magnitude aftershocks from a possible underground nuclear explosion before their rate and magnitude decay to levels too small to detect. Seismic sensors need to be placed within a few kilometres from the source for adequate detection and identification of aftershocks. Thus, the task of the IT is to seismically monitor as much of the inspection area as possible in the shortest amount of time. This process can be greatly impeded by weather and terrain. In addition, other seismic sources such as local natural seismicity and mining activities have to be located and identified.

Russian IT search strategy. In this exercise, the Russian IT approach was to maximize the initial use of sensors. Toward this end, they immediately employed all of the 30 seismic sensors available, in a 4-km grid, starting with the alluvial valley in the central part of the inspection area. The reasoning behind this approach is based on experience which suggests that aftershock rates decline most rapidly when a test is conducted in alluvium. Every two to three days, the Russian IT would relocate about one-third of the instruments to continue the systematic coverage of the grid, with the goal of covering the entire 1000 km^2 inspection area. This grid deployment was generally not strongly affected by the type of terrain (desert, mostly open country with good off-road general access) in the U.S. scenario. The grid approach proved to be extremely effective because the Russian IT very quickly began detecting aftershocks from the UNE postulated for this scenario.

Once a set of events had been detected by the Russian IT (in this case from mining activities and from the UNE), they allocated one additional seismic instrument from the predesigned grid pattern to double the coverage of events coming from the mining area and continued using the remaining instruments to further extend the grid coverage. This single instrument did not sufficiently supplement the detection capability to allow the team to obtain the precise locations, especially depth, needed to fully discriminate between seismic events related to active mining and aftershocks from a UNE. The fact that this additional station did not significantly improve event depth determination was due to a feature of the algorithm used by the U.S. data team for event location that was inadvertently not revealed to the Russian team. (The algorithm required that 3 stations detect an event before a depth estimate was revealed; otherwise the depth was given as zero.) Thus in this case an issue of ground rules had an important impact on search strategy. By continuing the grid search the Russian IT eventually found aftershocks from the earthquake that had occurred in another part of the inspection area. This brings up an important question: When a suspicious phenomenon is found, should the IT stop the search or continue to explore the whole area?

United States IT search strategy. The approach of the U.S. IT in the Russian scenario was quite different from that of the Russian IT. Based on an initial assessment of the inspection area map, target areas of interest were identified and prioritized for sensor deployment. The initial deployment involved placing two to three sensors at each of five different sites of interest (none of which, as was later discovered, included the actual location of the UNE). Not all of the sensors available were initially deployed. This approach was partly dictated by the nature of the terrain: dense forest, few access roads, little outcropping rock, and many swampy areas. After the initial deployment, the U.S. IT realized that most of the data being received was local noise, but there were some events in the central part of the inspection area that looked suspicious. Additional sensors were then deployed in that area to obtain a better characterization. Eventually, sensors from other areas were redeployed until about 15 sensors were in place covering about a 5 to 10 km^2 area. This allowed the U.S. IT to obtain a better understanding of the distribution of aftershocks and eventually to identify the hypocenter of the UNE within 400 m.

Unforeseen differences in the way the Russian and U.S. data teams simulated the seismic data required the U.S. to adapt its deployment strategy. The U.S. team initially expected that very local noise events at a site would be "discriminated" and not appear as events to a station; but the Russian control and data teams assumed that discrimination was not possible and included them as events. This necessitated deploying additional instruments around a potential target and required that detections and locations be based on two or more stations. This eliminated the value of any single-station locations. This type of ambiguous data situation is realistic and requires rapid evaluation in the field by the seismologist and immediate changes to the deployment strategy.

Comments on search strategy. The U.S. IT could have been more aggressive about the initial deployment of seismometers. Instead of waiting to obtain more information from the overflight or from visits to other sites, it would have been more advantageous to deploy as many sensors as quickly as possible. Because of the nature of the terrain in the Russian scenario, however, a grid-based approach would have been difficult to carry out. The importance of adapting the deployment strategy as information is gathered was aptly demonstrated by the U.S. and Russian IT experiences.

While a grid-based search can be very effective given certain terrain conditions, an IT should also be very flexible in adapting to information as it is collected. Once a set of events is identified, sensors should immediately be deployed or redeployed to obtain a better characterization of those events.

Effect of terrain and weather on sensor deployment. Finally, the exercise helped to focus attention on the fact that the time needed for deployment of seismic sensors will be strongly dependent on the local terrain and weather conditions and it is important to take this time into account in tabletop exercises. In this exercise, both ITs were operating under almost ideal conditions (as agreed by both sides since play of logistics was not to be a major issue for investigation). The logistics of installing seismic stations and the base station for telemetry and processing will, in practice, have a very strong effect on the overall deployment strategy. The question of the amount of time needed to deploy instruments, set up the overall telemetry and data collection system, and integrate operations needs further investigation, bolstered by data from real field experience. A computerized system is required to realistically model the time aspects of the deployment of both seismic and radionuclide sensors.

3.4. Radionuclide Detection and Analysis

The purpose of the radionuclide collection and analysis portion of the U.S./Russian joint tabletop exercise was to search for the presence of "fresh," man-made radioactivity, interpret the source of this activity, and, if possible, date the origin of the activity. Together with visual and seismic information gathered in the inspection area, the radionuclide measurements were used to determine the likelihood of a possible nuclear test conducted by the ISP.

There were five kinds of samples to be analyzed (soil, water, swipes, subsurface gas, and atmospheric air) for the signature radionuclides listed in Table 1.

Table 1. Signature Radionuclides Permitted to be Reported in this OSI Tabletop Exercise

"Particulate" Isotope	Half-life	Noble Gas Isotope	Half-life
^{95}Zr	64.0 d	^{131m}Xe	11.84 d
^{95}Nb	35.0 d	^{133m}Xe	2.19 d
^{140}Ba-^{140}La	12.75 d – 1.678 d	^{133g}Xe	5.243 d
^{141}Ce	32.5 d	^{135}Xe	9.14 h
^{144}Ce	284.9 d	^{37}Ar	35.0 d
^{147}Nd	10.98 d		

The principal analytical tool for (simulated) radionuclide analysis for this exercise was gamma-ray analysis from both high-purity germanium (HPGe) and NaI(Tl) detectors. The sodium iodide [NaI(Tl)] detector was used on both overflight and ground-based surveys in the gross-activity mode, with no spectral information being used to identify radionuclides from their gamma-ray signature. The particulate isotopes could be observed in soils, water, swipes, and in atmospheric samples (acquired by pumping air through a paper filter that was subsequently analyzed) with an HPGe detector.

In the case of the noble gases, the samples were acquired in either of two ways: as subsurface samples, gathered by pumping on perforated metal stakes that had been pounded a number of metres into the ground or as atmospheric samples, collected by pumping air through cold traps and activated charcoal traps. In the latter case, the Xe noble-gas isotopes were physically separated from their elemental homologues and counted automatically, using beta-gamma coincidence techniques, in a (simulated) unit built especially for the purpose. The ^{37}Ar samples had to be counted separately in an internal proportional counter due to the low energy of ^{37}Ar decay emissions.

In this exercise, the collection and analysis of these samples was notional (i.e., the processes were merely assumed to have taken place, but did not actually occur). The logistical aspect of the exercise was, for the most part, ignored, though some attempt was made to limit the number of samples that could be processed in any given inspection period to simulate what would be reasonably achieved with the equipment and personnel assumed to be available.

Alternative methods of sample analysis. The Russian IT introduced a mobile laboratory for the purpose of collecting and preparing samples for counting as the laboratory was being moved from the field to the base camp. This would reduce the average amount of time required for analysis of each sample. The U.S. control team allowed the use of this vehicle, even though it had not appeared on the list of approved equipment. It was felt that while this innovative laboratory could be effective in relatively flat terrain where its travel would be relatively unimpeded, its mobility would be limited in rough and rugged terrain such as that found in parts of the inspection area of the U.S. scenario. The exclusive use of a mobile laboratory might limit sample collection if sampling locations are far from one another, but could increase the expected analysis throughput since sample preparation can begin as soon as the sample is in the mobile laboratory.

Use of isotope ratios. In the development of their scenario, the Russian exercise planning team chose not to employ more complex radionuclide signatures, such as isotope ratios like $^{133m}Xe/^{133g}Xe$, capable of identifying and dating source terms of the measured activity. The Russian Federation and the United States consider the identification of these source terms and their interpretation critical to the OSI mission, and therefore they should be exercised as fully as possible. The U.S. scenario provided for the measurement and reporting of isotope ratios, including Xe ratios and particulate radionuclide ratios, from a diversionary source (a nuclear reactor) just outside of the inspection area boundary. However, the Russian IT chose not to investigate this diversionary source, relying on seismic information to lead them to the critical location. They subsequently obtained subsurface gas samples and identified the location of the UNE from the presence of ^{37}Ar in these samples. Isotope ratios, although measured, were not utilized in the interpretation of this scenario.

Constraints on sample analysis. Certain radionuclide measurement characteristics (how long one must count to achieve certain limits, for example) need to be examined in order to better understand the limits on sample preparation and counting. An effective result of gamma-ray (HPGe) analysis of a soil or water sample is either the actual activity of a given signature radionuclide (for example, 64-d ^{95}Zr) or an upper limit of the activity of this nuclide if it cannot be definitely shown to be present (sometimes reported as the Minimum Detectable Concentration, or MDC). There is a tradeoff between the length of the counting interval (and the precision or MDC) and the number of samples that can be counted. This choice needs to be examined more closely both to understand the constraints in a real OSI as well as to simulate more realistically these situations in an exercise.

Noble gas systems. The current capability for collecting, purifying, and counting noble gas samples is largely unknown at this time. It is necessary to understand the kind of equipment that is commercially available or in need of development for noble gas sample treatment. Such equipment should be smaller and more portable than the Pacific Northwest National Laboratory (United States Department of Energy) Xe Automated Radioxenon Sampler/Analyzer (ARSA) system proposed for use by the CTBT IMS which was used notionally in this exercise.

Radionuclide gas migration to the surface. Both the U.S. and Russian scenarios included artificial assumptions on the migration of radioactive gas to the surface to permit the IT to conclusively find the UNE when gas samples were collected in the proper locations. It should be noted that these radioactive gases may not have made their way to the surface within a month or so after the explosion.

3.5. Logistics and Other OSI Operational Issues

While both the United States and the Russian Federation agreed that logistical issues would not be a focus of this joint tabletop exercise, favoring instead to examine technical and operational OSI issues, some logistical issues inevitably arose. Some assumptions were needed regarding the amount of time needed to transport and deploy instruments in various terrain, the capacity of various transportation equipment, and other parameters, to provide a realistic framework within which to conduct the scenarios. For example, it would be unrealistic that an IT could deploy all of its equipment in one day to any location of the inspection area. Therefore, for the technical and operation lessons learned to be valid, the logistical constraints that an IT would face need to be simulated.

Although both sides agreed that some logistics needed to be taken into account, each side approached this differently; this led to some disagreements and provided an opportunity to explore some OSI logistics issues in greater detail. This section will summarize some of those lessons learned as well as discuss other general OSI operational issues.

Sensor deployment times. While there is a general understanding regarding the length of time required to deploy various sensors, more precise data need to be collected to fully comprehend the limitations (time, terrain, weather, etc.) that sensor deployment times will impose in successfully conducting an OSI. For example, the U.S. and Russian participants had different opinions about the length of time required to deploy seismic sensors within the inspection area. Understanding this more precisely could impact, for example, the choice of a search strategy in a given area. Likewise, deployment of radionuclide sampling equipment would provide more precise data regarding the resources required to effectively monitor an inspection area. Such data could also greatly impact OSI planning and resource allocation by providing the IT leader with greater insight into how to prioritize the necessary inspection activities and techniques based on available resources (e.g. transportation, personnel, equipment, etc.). It would also provide the IT leader with knowledge about which kinds of deployments and processes deplete existing resources most quickly.

Transportation. During this exercise, it also became clear that there needs to be more advanced agreement on the type and capacities (including cargo and passengers) of various vehicles used by the IT (not only for the scenarios but also in planning for an actual OSI), as there were differing views expressed during the exercise. Such information is critical to understanding the limitations that an IT will encounter during an OSI and how logistical constraints will impact the ability to capture the rapidly decaying phenomenology following any event likely to trigger an OSI.

Logistical impacts of sample chain-of-custody. While it is understood that sample chain-of-custody will need to be maintained for various types of samples, the degree to which this will impact the rate of data analysis during an OSI is not yet clear. When the procedures for chain-of-custody are fully developed, it will be necessary to examine the time delays that may be introduced into the sample collection and analysis process to understand how this may impact the conduct of an OSI.

Data management and decision-making. During the course of the exercise, it was evident that one of the most challenging aspects of an OSI was establishing a decision-making and data management process. Not only is it important that the IT have a data management computer program such as a geographic information system to organize and display the data by location, the IT also needs to determine, either in general or prior to a particular inspection, what criteria will be used in the decision-making process during the OSI.

Conduct of future tabletop exercises. This exercise demonstrated the need to have pre-planned and agreed logistics data from which to conduct the inspection, so that such issues will not detract from exercises that are designed to focus on the implementation of inspection activities and techniques. An initial effort was demonstrated in the Russian scenario using a computer-generated logistics program, which was quite realistic and helpful in determining travel times. This effort should be expanded for incorporation into future tabletop exercises. In addition to supporting more data-intensive exercises, such a computer-based program itself could be tested in a logistics-based tabletop exercise to refine such information for use in future CTBT OSI training courses for inspection team members.

3.6. OSI Overall Strategy Lessons Learned

The following section provides some insight into the various actions taken by each of the joint tabletop exercise teams as they simulated an IT or an ISP team, and attempts to reveal some of the factors that impacted the use of that particular team's strategy.

U.S. IT strategy. In an attempt to quickly reduce the search area, the U.S. IT used a focused search strategy, wherein even initial search activities were concentrated on areas, features, or facilities that were judged to be of higher interest than other areas. Passive seismic sensors, radionuclide sensors, and soil gas collectors all were placed near features more likely, in the eyes of the U.S. inspectors, to be possible locations for a possible nuclear test. Even the initial overflight and ground-based visual observations concentrated on portions of the inspection area that were judged a priori to have a higher probability of having hidden a possible nuclear test.

The U.S. team search strategy was based on the assumption that massive amounts of material must be hauled into, and perhaps out of, the location of a possible nuclear test. Thus regions with poor or no roads tended to be discounted in favor of areas where load-bearing roads existed. The Russian scenario included a site, introduced to divert the inspectors, that looked quite similar to emplacements used by the RF at their former nuclear test site at Semipalatinsk. This site was in fact given only cursory treatment (observation and swipe sample collection) by the U.S. team because of perceived flaws in the details of the site that did not conform to likely testing practice. While this was clearly a gamble by the IT, it paid off by enabling the team to spend more time on other areas and ultimately to locate the UNE.

Actions of the U.S. IT brought to focus the issue of how the 12 hours allocated to the initial overflight will be used. Issues of what constitutes allowed flight time (e.g. when the "clock" starts) and whether time can be allocated in segments over several days surfaced. These issues involve interpretation of the Treaty and are being actively discussed by the Preparatory Commission Working Group B and need to be well defined in the OSI Operational Manual.

Adverse weather conditions were not played out due to the already severe time constraints of this exercise. Yet weather, under both the Russian and the U.S. scenarios could seriously hinder conduct of the OSI and could modify the IT's strategy. Rain or cloudy weather could have prevented overflights, slowing progress. In the Russian scenario, rain could have impeded travel over dirt roads. In both scenarios, snow cover could obscure any indications of past off-road travel and impede installation of instruments such as seismometers. Perhaps most importantly, extreme low temperatures could severely limit the allowable working time of the IT. These aspects should be considered in future tabletop exercises.

Russian ISP strategy. The Russian ISP, like the U.S. ISP, was generally cooperative in granting permission to the IT to go to subsections of the inspection area. The Russian ISP exercised its Treaty-prescribed prerogatives to take 36 hours at the POE in order to examine the equipment brought in by the U.S. IT, mainly to ensure that the equipment met technical specifications and that it did not provide additional measurement sensitivities or other capabilities. More generally, the Russian ISP tended not to grant permission to the U.S. IT to do anything that was not explicitly permitted in the Treaty.

Russian IT and U.S. ISP strategies. In contrast to the initial, focused search strategy employed by the U.S. IT, the Russian IT consciously chose a more systematic, grid-like, wide-area search strategy. Passive seismic sensors, radionuclide sensors, soil gas collectors, and even the initial overflight were initially spread widely over the entire 1000 km^2 inspection area. Subsequent redeployments of each of those assets then became more focused in a gradual way compared with the U.S. team approach which was less systematic.

The Russian IT, as did the U.S. IT, asked to use all 12 hours of overflight after its original grid search was completed, but did not insist when the U.S. ISP introduced a (relatively low) barrier by stating that the requested helicopter was not available for a few days. The U.S. ISP would have been willing, if the Russian IT had persisted, to make available a fixed-wing aircraft four to five days later. In this regard, the U.S. ISP attempted to demonstrate some flexibility regarding the availability of the full 12 hours of overflight time beyond just the first couple of days, but called attention to the fact that aircraft are expensive to have “on call” and that fixed-wing aircraft are a permissible, if less useful, platform for OSI overflights.

The U.S. ISP, like its Russian counterpart, tended to be quite cooperative in terms of granting permission for the Russian IT to conduct its activities. The sensor deployment strategy of the Russian IT stressed the assumed U.S. ISP vehicle and escort capabilities, reflecting the more careful attention by the Russians and their logistics computer model to more realistic simulation of at least the temporal aspects of logistics capabilities.

The U.S. ISP was very generous in allowing the Russian IT to proceed to the inspection area without taking the full time allowed for examining the inspection equipment at the POE. While such action allowed the exercise to start off on a note of cooperation and allowed the exercise to proceed more quickly (without much exercise time being consumed by POE activities), it may be unrealistic to expect an ISP not to examine OSI equipment more carefully at the POE—both from the standpoint of suspicions of surreptitious data-gathering capabilities and from the standpoint of allowing the IT to arrive at the inspection area earlier when any aftershock activity is more likely to remain and be detectable. On the other hand, in order to meet the Treaty timelines, it may be realistic to defer such in-depth equipment inspection until arrival at the inspection area when the operational checks are conducted for the inspection equipment. (NOTE: Since different views exist on the meaning of equipment inspections, it may be useful to clarify such activities in the OSI Operational Manual in more detail.)

Because of the time compression employed in this exercise, several days of simulated inspection time would pass between periods of data exchange between the ISP data team and the inspection team. Thus the IT would get several days of data at one time. This often frustrated the Russian IT because it did not allow day-to-day adjustments of the inspection plan that might result from having near real-time data (such as telemetered seismic data). However, in a real inspection other data (e.g., soil gas samples that must be collected for a several-day period and take considerable time for analysis) might not be available for several days.

The Russian IT wished to have continuous video as well as occasional still photos during the overflight. Since the Treaty says that the ISP shall have the right to provide its own camera operator, this brings up obvious implications for the number of personnel required to be on the flight at any one time. This is a matter of Treaty interpretation that should be addressed in the OSI Operational Manual.

4. EXERCISE PLANNING LESSONS LEARNED

In addition to providing a vehicle for understanding various technical and operational issues associated with CTBT on-site inspections, the U.S./Russian joint tabletop exercise was useful in gaining insight into the utility of such exercises as a tool for examining various OSI issues. As such, it also provided an opportunity to record some lessons pertaining to the implementation of tabletop exercises. This section will detail some of these lessons in two sections: the first discusses general lessons learned pertinent to exercise development and execution, while the second discusses lessons related to data preparation and presentation.

4.1. Exercise Development and Execution

While any simulation exercise requires a great deal of planning and preparation to successfully execute, the planning, preparation, and execution time required for any such exercise in a bilateral or multilateral setting will be significantly greater due to the many complexities that such an environment creates. While participants may agree on the objectives of the exercise and even conceptually how it ought to be implemented, not everyone will agree as to how this is best accomplished. And, even though agreement will eventually be reached on these points, differences will still remain and not become evident until the actual execution of the exercise. This was perhaps the principal lesson learned through this exercise-planning experience.

In the course of this tabletop's development and execution, there were a number of instances in which participants failed to reach a complete understanding of issues, even when everyone believed such issues to have been thoroughly explored and resolved. This section of the report will discuss what steps may be taken to minimize the possibility of such misunderstandings between fellow planning team members as well as some of the lessons believed to be relevant and useful to planners of subsequent CTBT OSI exercises.

Communication between planning team members. Much of the success of this exercise is owed to the extensive communication within the U.S. and Russian teams as well as between the respective planning teams. While not all members of the U.S. and Russian exercise planning teams met regularly, all of the subject matter experts who needed to communicate with their counterparts did so, usually via e-mail. Early in the planning phase of the exercise, participants established how they would communicate and what subjects would be communicated. Nevertheless, disagreements arose during the exercise because of different interpretations of the details of the ground rules.

Designation of an alternate control team head. It is important that the primary coordinator on each side have a designated alternate who can be called upon in the event the primary exercise coordinator is not available, both to continue to interface with members in that team as well as with members of the other planning team.

Separation of the control team from the ISP and the IT. The control team should act as an independent entity with clear separation from both the IT and the ISP. The only function of the control team should be manage the play of the exercise and adjudicate any areas of disagreement.

Documentation of agreements made. In the preparatory phase of an exercise, it is vital to clearly document all of the meetings held and agreements reached among participants. This documentation should then be reviewed by all participants and checked for accuracy, since all team members will use these documents as reference materials when the scenario and supporting data are generated. One particular document developed by the exercise planning team was a set of *operating assumptions*, which detailed key elements that would assist in shaping the direction of the exercise. For example, the *operating assumptions* included decisions regarding the role of the evaluation team, the scope of the exercise, and the level of data processing that would have to be done by each IT.

Exchange of data. At various times during the planning phase of the exercise, the U.S. and Russian data teams exchanged data to verify formats to be used during the exercise as well as to provide preliminary scenario data, such as the consultation and clarification (C&C) package. While data exchanges to verify data formatting helped to minimize confusion between the teams, more extensive data exchanges should be done in the form of a limited practice exercise, or "dry-run." The teams would use mock data to verify what kinds of data the teams would see during the actual exercise.

Additionally, since it would be impractical to do practice exercises with the C&C package because it contains scenario information, each control team could pass the C&C package to a third party, who could verify that the package contained all of the intended information, including maps with legends, images, and other supporting information. As an example of the type of problem that can arise, the map transmitted to the U.S. IT with the C&C package did not have a legend, scale, or reference grid. This inhibited development of the U.S. IT inspection plan. There was no time to obtain the missing information prior to traveling to the Russian Federation since the joint U.S./Russian exercise planning team had agreed, as part of the operating assumptions, that the C&C package exchange would take place shortly before the team departed, to simulate the length of time a real IT would have to develop an inspection plan. Prior checking by a third party could have helped to alleviate this difficulty in a timely manner.

Method of exercise implementation. Because this joint collaboration was planned as two scenarios with a reversal of roles by the U.S. and Russian sides in each scenario, there existed between and among the teams a combination of mutual encouragement and competition. That is, each team wanted to perform well its assigned role for each scenario, and each IT, in particular, strove to uncover the true nature of the scenario that the other side had constructed. This resulted in some intense periods in which certain aspects of genuine difficulty in data generation by the U.S. data team were misinterpreted by the Russian IT as delay tactics by the U.S. ISP. This also resulted in accelerated attention to certain areas of the inspection area, as opposed to a more systematic approach to inspection. Other methods of implementing bilateral tabletops could be explored that would minimize any feeling of competitiveness between teams and allow both sides to focus more on the process used by the IT rather than the inspection results that each IT might achieve.

Role of exercise controller. The exercise controller's main function is analogous to that of the director of a play — this individual is responsible for ensuring that all participants understand and execute their roles at the appropriate time and that all are aware of the status of the exercise. The controller should be very familiar with the exercise scenarios but should not have any other role during the execution of the tabletop.

Time compression. While it is necessary to have some time compression in a tabletop exercise, that compression should not impede the ability of the exercise to evolve naturally and to reveal relevant issues. When time compression is too great, participants tend to rush through certain aspects of an exercise and become focused on getting through a minimum number of inspection days. This places the IT members in a state of mind not conducive to exploring the inspection area in a manner consistent with what would be done in the field and interferes with the natural evolution of the exercise. A compression of 2.5 days to simulate 25 days of an inspection is too great; four or five days would have provided a sufficient amount of time.

Use of individual computers for data generation. Initially, the exercise planning team debated whether the U.S. side could bring its own computers or should rely on the host (RF in this case) to provide them. Finally, it was decided that certain data team members would bring their own computers. This proved to be very important for efficient data production. Data could be generated in the midst of discussions, in the back of the main room or elsewhere. In addition, data team members were intimately familiar with their own data sets, application software, and operating systems, which permitted rapid data production and analysis. The decision to allow U.S. team members to bring their own computers was crucial in assuring the success of this exercise.

Playing logistics in a tabletop exercise. An innovative approach to track logistics used by the RF in their scenario was a computer program designed for a number of bookkeeping tasks. Based on a digitized map of the Russian inspection area, this program kept track of overflight and ground-based visual observations, vehicle movement, sampling locations, and seismic sensor placement. This program substantially facilitated the exchange of information between the ISP and the IT. Future improvements and additions to the program could result in greater emphasis on the logistical aspects of an exercise such as the metering of travel time, the allocation of personnel, and their use in the field according to their specific skills. Such a program could ensure that the resources (time and equipment) and the limited number of personnel with specific skills were actually available to perform specific tasks. In addition, aspects of an OSI such as weather and the results of sample analyses or seismic sensor readings could be played out more efficiently.

4.2. Data Preparation and Presentation

Presentation of simulated data in a tabletop exercise presents unique challenges. In a real inspection, inspectors will be faced with ambiguous or "noisy" data, in an informational sense. It is important in the play of the exercise to try to incorporate this uncertainty in "hard" data, such as radionuclide measurement results and seismic data, and especially in "soft" data such as visual observations. What is desired is a method that forces the inspection team to make decisions in a noisy environment that mimics possible real situations. Both the Russian and U.S. data teams approached this problem differently; the results are discussed below.

Presentation of overflight data. The U.S. data team presented summaries of overflight observations in a verbal format, not photographs; a member of the U.S. data team orally described what the Russian IT would have seen at the place where the RF IT had said it wanted to conduct a visual observation. Although this approach allowed the U.S. data team to excerpt relevant portions from the materials prepared in advance, the Russian IT did not believe this to be an effective mechanism to convey to them the results of an overflight even though they could ask questions of the U.S. data team, who could add extra clues or withhold information depending on what was appropriate at that time in the inspection activities. Yet, the alternative approach of presenting visual data in the form of photographs also had significant problems and limitations, as discussed below.

Use of photos and schematics to convey ground-based visual observations. The ground-based visual data, as presented by the Russian data team, relied heavily on photographs. This resulted in the U.S. IT asking many questions that were unrelated to the information that the presenter intended to convey, but instead were unique to the photo being displayed. While some photos can be invaluable for informing exercise members of the terrain they will be entering, too much dependence upon photos may be harmful or distracting to the exercise. Schematics, alternatively, provided minimal information focused on a particular feature, but seemed to speed up the exercise, offering the chance to ask questions about features more relevant to the IT's investigation.

Improving visual data presentation. While the use of narrative, supplemented with photos and diagrams has been found to be the most effective way to convey visual observation data, this approach is very time consuming. Alternative methods have been explored but would require a substantial amount of development to become applicable to CTBT OSI tabletop exercises. One alternative for conveying data more quickly would be to have a number of inspection activities proceeding simultaneously during the course of the exercise. For example, some members of the IT could listen to the visual observation data presentation, then summarize it for the remainder of the team. This would also simulate more realistically how an in-field exercise would proceed.

Automation of seismic data generation. During a previous internal U.S. tabletop exercise, processing of seismic data was carried out manually. This proved very time-consuming and was a limiting factor in the play of the exercise. For the joint U.S./Russian tabletop exercise, computer programs were used that greatly improved data processing. The U.S. data team provided a printout of daily event catalogs and plots of event locations, which aided the Russian IT in its analysis and interpretation of the data. The turnaround time, however, for the U.S. data team to produce the data was limited by another factor—the time it took to cross-check the deployment logistics. For each exercise period, the Russian IT would provide the U.S. data team with a list of new locations for seismometers, which had to be checked to determine how long the deployments (or redeployments) would take. This process, which was done manually by the U.S. data team, took at least 30 minutes for each exercise period. The final seismic data could not be produced until all of the sensor locations were known, so the logistical evaluation of the installation became a limiting factor in the data team response.

Deployment time checking was not an issue for the Russian data team because travel and installation time calculations were built into their computer program. Future exercises should also include a capability (preferably automated) to calculate the time needed for transporting and setting up the seismic base station, telemetry, and analysis equipment as well as base camp radionuclide analysis equipment, and quality assurance and sample tracking procedures, etc.

Seismic data format. Initially, the Russian side wanted to have the IT determine event locations from raw P and S wave time pick data provided by the data team. The resulting event locations, determined by the IT using a computer code for hypocentral determination, would automatically include the uncertainty introduced by station distributions, picking errors, and the earth velocity model used, as would be the case in a real inspection. While this approach provides maximum realism, the U.S. data team argued that such an approach was not practical because of the time needed for the data team to generate travel time data and the time needed by the IT to process the data. During each period for which a new arrangement of seismic stations was in place, the data team would need to produce a complete set of compressional and shear wave arrival times for each simulated event at each detecting seismic station, with consideration of picking errors based on signal-to-noise ratios and the seismic velocity model for the inspection area. The IT would then have to run all of this data through a location code with some assumed velocity model to determine the locations of the detected events.

Since data analysis was not considered to be a goal of this exercise, the joint exercise planning teams decided that, even with the use of computers, having the IT analyze data would require too much time and divert attention from the stated objectives of the exercise. In addition, prior to the exercise, the U.S. control team had insufficient time and resources to automate the exercise and coordinate the computer code with the Russian counterparts. It was finally agreed that for each exercise period, the data team would use a set of predetermined event locations and the current station configuration to compute a set of detected events with built-in location uncertainties. No data processing would be required of the IT.

The U.S. and Russian sides agreed on most of the important aspects of seismic data processing (e.g., attenuation rates to use for seismic signals, aftershock occurrence rates from explosions, calibration of sensor signal strength to magnitude, signal-to-noise ratios for detection and identification, formats for data output, etc.) relatively early in the planning stages. However, since both data teams were still developing the computer codes for seismic data processing when planning meetings took place, there inevitably were some differences that arose during the exercise, such as the U.S. seismic depth determination algorithm already mentioned. Another example of a miscue in data exchange was the fact that the Russian data team did not provide the U.S. IT with either a table or location map of the detected events; this added to the time needed for data analysis by the U.S. IT. These issues could not be remedied at the time of the exercise because it would involve modification of previously prepared computer codes.

In future exercises, it would be beneficial to verify data formats, in detail, prior to the start of the exercise. This could be accomplished by allocating a short period of time during which several data exchanges could take place between data team members and IT members, utilizing mock data. This would preferably be done several weeks in advance of the exercise to allow for modifications of data generation systems. An alternative would be to use a common computer platform (machine and software) that all participants are familiar with.

Simulating the effect of noise in seismic monitoring. The most substantial difference between the U.S. and Russian simulation of seismic data in the exercise was in the manner in which seismic noise was handled. The U.S. data simulation assumed that an automated system or analyst would be able to eliminate most nonnatural noise sources local to a single station (such as heavy equipment passing the sensor or heavy machinery operating nearby). Thus, for the purpose of the exercise, an event detection reported by the data team would be considered to be a real seismic event such as an earthquake aftershock, mine explosion, or explosion aftershock and not local noise, even if it were detected by only a single sensor. The Russian data team, however, took a different approach. In their scenario, the Russians wanted to simulate difficulties that could arise from locally generated noise (intentional or otherwise). Hence, the bulk of the "detected" events were single-station detections, indicating a very local source. The only "real" seismic events (aftershocks from the UNE) were events detected by multiple stations. Once the U.S. IT understood this aspect of the data generated by the Russian data team, it was relatively easy to identify the source of aftershocks.

Use of ^{37}Ar in tabletop exercises. ^{37}Ar is produced almost exclusively by the interaction of high-energy neutrons with natural calcium in the surrounding medium of a nuclear test. As such, it is virtually a forensic "smoking gun" for the identification of non-compliance with the CTBT. Although the actual transport of ^{37}Ar by periodic upward gas flow driven by lowered surface atmospheric pressure (known as "barometric pumping") from the detonation point underground to the surface may take months, it is tempting to generate an ad hoc presence in the exercise (e.g., a pressurized leak, used in both scenarios) to construct a simpler and more definite signature of noncompliance. Consequently, the removal of ^{37}Ar as one of the "reportable" radionuclides should be considered for future OSI exercises in order to require the generation and subsequent interpretation of complex radionuclide signatures that would exercise more realistically the steps an IT would need to take in an OSI. Such interpretation of possibly ambiguous radionuclide signatures may be necessary to complete the mission of an actual OSI, whether a possible nuclear test has been executed or not.

5. REPORT OF THE EVALUATION TEAM

The U.S./Russian joint tabletop exercise participants included two Russian and two U.S. evaluators who observed and evaluated the exercise. The evaluation team members were selected because of their technical expertise as well as their extensive first-hand knowledge of testing issues, the CTBT negotiations, and Preparatory Commission discussions regarding the CTBT verification regime. The evaluation team provided a written statement containing its collective assessment of the conduct of the exercise. Five additional U.S. observers, representing the Department of Energy (DOE), the Arms Control and Disarmament Agency (ACDA), and the Department of State, also attended the exercise and provided their observations to the group informally. The following evaluation is based primarily on the report of the evaluation team. However, it includes input provided by the observers as well.

The team based its evaluation on the four objectives of the exercise:

- To simulate the actions of the IT, including interactions with the ISP, in order to examine different ways the United States and the Russian approach inspections and develop appropriate recommendations for the international community.
- To identify ambiguities and contradictions in the interpretation of Treaty and Protocol provisions that might become apparent in the course of an inspection and that need clarification in connection with the development of the OSI Operational Manual and OSI infrastructure.

- To confirm the efficacy of using tabletop exercises to assist in developing an effective CTBT verification regime.
- To identify strong and weak points in the preparation and implementation methods of such exercises for the purpose of further improving possible future exercises.

The evaluators and observers concluded that the tabletop exercise succeeded in achieving its objectives. It illuminated a number of practical issues that will arise during actual on-site inspections under the CTBT. The lessons learned will help the United States and the Russian Federation prepare for implementation of the Treaty and lay the groundwork for further bilateral cooperation in this field. The group recommended that the experience gained from the exercise be shared with the CTBT Preparatory Commission, in Vienna, to help it prepare to implement the on-site inspection regime in the Treaty, including inspector training, Operational Manual preparation, and equipment selection.

The evaluators commented that the scenarios used in the exercise were challenging without being overly complicated, allowing both sides to practice several aspects of real inspections. An appropriate amount of detail was provided, and the scenarios were internally consistent. At the same time, the evaluators noted that in future exercises, the control teams should better define the ground rules and basic assumptions that will be used. Further, these assumptions should be clearly agreed upon in advance and recorded in written form. In this exercise, participants appeared to begin the exercise with different assumptions regarding certain elements, including background seismic noise, equipment to be used, and certain logistical constraints.

The exercise highlighted the importance of precision and clarity in communications between the IT and the ISP team. When more than one language is used, the availability of high-quality interpretation is essential. Even with the relative simplicity of this exercise and the services of excellent interpreters, a few misunderstandings and delays occurred owing to communication problems. In an effort to improve communication, the evaluators recommended that, in future bilateral exercises, the U.S. team should provide at least one interpreter who is a native English speaker. In addition, all interpreters should be trained for technical as well as nontechnical interpretation.

In this exercise, the large amount of information initially supplied to the IT slowed the beginning of the exercise. It would be more realistic for the team to have in its possession not only the information developed during the C&C process and the debate in the Executive Council, but also the information that would presumably be supplied by the Technical Secretariat—maps of the region, for example, the location of all operating nuclear reactors in the area, and perhaps relevant unclassified satellite imagery.

The exercise confirmed that the duration of the exercise and rules imposed influence the effectiveness of the simulation process and decision-making. In some cases, the time compression imposed during the scenarios prevented the IT from thoroughly considering data and developing a unified deployment and sampling strategy. In the future, scenarios of a similar scope should be allotted at least four days.

Further work should be done to achieve greater realism in the exercise wherever possible. In particular, it would be useful to exercise logistical issues that could arise during an on-site inspection. For example, future exercises could address issues associated with the geographic separation of subgroups, communications, chain of command, equipment failures, illness, inclement weather, and unexpected logistical problems.

Similarly, the interactions between the IT and the ISP were played out in this exercise in a highly cooperative manner, which was appropriate for this stage of our work. As a result, the focus was primarily on data collection and interpretation, rather than on negotiation. In future exercises, we may wish to consider more adversarial scenarios, in which negotiation and compromise play a greater role. It would also be useful to further practice interviewing techniques, including those for dealing with uncooperative or untruthful subjects.

The strategies used by the ITs were effective in gaining relevant information within the constraints imposed by the scenarios. Both ITs divided themselves roughly into visual observation and seismic and radionuclide subgroups and operated efficiently. There were differences in approach, however. For example, the U.S. IT used a cautious initial approach, both in the use of its initial overflight and the targeted placement of a few sensors near suspect sites. The Russian IT, alternatively, decided to cover, as soon as possible, the entire inspection area on its initial overflight and to deploy the maximum number of fixed seismic sensors. In both scenarios, the IT discovered the suspect explosion toward the end of the exercise.

The evaluators noted that seismic and radionuclide sensors and data lend themselves well to simulation. The simulation of visual information and the use of such simulated information, obtained from overflights and ground-based visual observation are much more difficult. In this exercise, the latter was rather time-consuming and not entirely realistic, despite the best efforts of the participants. Realistic exercises in this area may require very elaborate and expensive simulations or perhaps must await exercises in the field. The evaluators and observers strongly recommended that the group investigate other approaches to presenting visual information to facilitate future exercises. One manner in which to assist with visual observation is to ensure that the IT is provided with maps of the region, the location of all operating nuclear reactors in the area, and perhaps relevant unclassified satellite imagery prior to the exercise. In addition, visual descriptions of areas could be presented in written form, and the IT members could respond to that information and request clarification when needed. One observer suggested that the IT leader provide the rest of the IT with a report (provided by the control team) at the end of each inspection day that would describe the main areas of interest observed by the visual observation team. This option would also more realistically simulate an actual inspection.

One of the most useful benefits of realistic simulations is the identification of problems related to differing interpretations of, or lack of clarity in, the Treaty. A few such issues arose, such as whether the initial overflight could be spread out over several days. It is important that such issues be identified and resolved in Vienna during the development of the OSI Operational Manual before entry into force of the Treaty.

The exercise also highlighted differences in interpretation of the types of equipment that would be used during an on-site inspection, for example, a mobile laboratory. Although no equipment was rejected by the ISP during this exercise, it seems evident that equipment issues such as certification, calibration and registration should be worked out to the maximum extent possible in Vienna, to minimize problems and delays related to equipment at the POE. In addition, it should be made clear in advance what equipment (for example, means of transportation) will be provided by the ISP at the POE and in the inspection area.

In this exercise, both ITs presented a brief verbal report to simulate their report to the Executive Council. In a longer, more realistic exercise, a detailed written report would be required.

5.1. Recommended Next Steps

The evaluation team recommended that another bilateral exercise should be held as soon as it can be properly prepared. It should incorporate lessons learned from this exercise, as well as greater realism. The sides should also move toward cooperative work using real instrumentation in the field. The eventual goal should be realistic multilateral trial inspections.

6. PROPOSED NEXT STEPS FOR U.S./RUSSIAN INTERACTIONS ON CTBT OSI

The Exercise Evaluators and Observers determined that the U.S./Russian joint tabletop exercise was valuable in highlighting policy, technical, and procedural issues that require resolution both within each national government and within the Preparatory Commission. It also allowed participants the opportunity to work through certain technical issues and operational details associated with on-site inspections in a cost-effective manner. Because of the value and success of the exercise, it is expected that this joint exercise is the first in a line of efforts of this type. Future activities should occur under the auspices of Working Group Three. The group identified three possible next steps, as noted below.

Additional Bilateral Tabletop Exercises. Through the development and implementation process of this first U.S./Russian joint tabletop exercise, the participants learned a great deal about conducting an effective tabletop exercise. The exercise highlighted policy, technical, and operational issues that need to be resolved before the CTBT Preparatory Commission completes the OSI Operational Manual. Additional tabletop exercises would provide an opportunity to flesh out such issues. Future exercises should address such issues as logistics, a confrontational or intransigent ISP, equipment failures, managed access, inspector illness, difficult weather conditions, and the continuation phase on an on-site inspection.

Multilateral Tabletop Exercise. The group noted that the Preparatory Commission would benefit from an exercise like this one. Such an exercise would provide participants with an opportunity to identify and resolve policy, technical, methodological, and logistics issues associated with conducting an on-site inspection. It is worth considering conducting a multilateral tabletop exercise in which members of the Preparatory Commission would participate as inspectors. U.S. and Russian policy and technical experts could serve as the control team for such an exercise or could participate as inspectors, as well.

Directed Field Exercises. The tabletop exercise made clear that adequate OSI procedures cannot be established until an equipment list is agreed, and there is a thorough understanding of the logistics associated with CTBT on-site inspections. Seismic monitoring, radionuclide sampling and visual observations each have associated with them specific logistical requirements and limitations. To address these issues in a cost-effective manner, the United States and the Russian Federation could hold their own internally directed exercises that isolate specific methodologies and technologies. At an appropriate time, policy and technical experts should build on these field exercises by conducting bilateral field exercises that would enable participants to refine methodologies and techniques.

APPENDIX I

RUSSIAN SCENARIO CONSULTATION AND CLARIFICATION PACKAGE

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Form Number: F06

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: State of Y

Precedence: Immediate

Subject: Request for Clarification

Index: CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06

References: None

At 14:00 GMT on 7 October 1998, the CTBTO received the following Request for Assistance in clarifying a matter of CTBT concern from the State of X:

A. Pursuant to Article IV.C., paragraph 32, the State of X requests the Executive Council to assist in clarifying a matter which causes us concern about possible noncompliance with the basic obligations of the Treaty by the State of Y.
B. On 3 October 1998, at 22:32:12 GMT, the International Monitoring System detected IDC Event 0654321, a 4.1 (m_b) magnitude seismic event in the vicinity of 35.2861N 165.1396E at a depth of less than ten kilometres.
C. In accordance with IDC event screening criteria based on a ratio of magnitude of surface waves to body waves this event with a high probability is of explosive nature. Before now such a level of explosive activity has never been detected by IMS in this area.
D. Request immediate consultation and clarification with the State of Y to resolve the concern about possible noncompliance.

The Executive Council forwards aforecited Request to the State of Y to obtain clarification pursuant to Article IV.C., paragraph 32 (b).

Remarks: None

End of CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06

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Form Number: F07

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: State of X

Precedence: Immediate

Subject: Response to Request for Clarification

Index: CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07

References:

1. CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06

Content:

At 12:43 GMT on 9 October 1998, the CTBTO received the following Response to Request for Clarification from the State of Y:

A. In response to the compliance concern stated in Reference A., the Government of the State of Y confirms a fait accompli of carrying out an explosion in the area mentioned in that request. This sub-surface chemical explosion of conventional explosive with total yield of 500 TNT took place on 3 October 1998 at approximately 22:32 GMT in the vicinity of 35.2200N 165.1892E, in a open-cast mine. This explosion was carried out within a framework of development of a new cost-effective method of crushing mining rocks.
B. A number of conventional explosions of about 100 TNT yield were carried out in this quarry earlier during the last year on a regular basis. These explosions were detected by IMS as 2.5 to 3.0 magnitude seismic events and did not cause any compliance concern.
C. None of IMS Radionuclide Stations detected any evidence of noncompliance. That network includes two Radionuclide Stations within 1,500 kilometres of the place of the above mentioned explosion detected as IDC Event 0654321, and one of these two stations is capable of detecting radioactive noble gases.

The Executive Council forwards aforecited Clarification to the State of X pursuant to Article IV.C., paragraph 32(c).

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Remarks: None

End of CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07

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Form Number: F08

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: State of Y

Precedence: Immediate

Subject: Request for Clarification

Index: CTBTO/DG/ODG/0001/1998/10/13/1400GMT/F08

References:

1. CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06
2. CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07

Content:

At 11:07 GMT on 13 October 1998, the CTBTO Council received the following On-Site Inspection Request from the State of X:

A. The State of X has thoroughly analyzed the data provided in Clarification Response of the State of Y (CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07) and deems them unsatisfactory. The State of X requests for instant on-site inspection in the area of the State of Y shown in Attachment 1. Additional data are provided below.
B. Boundaries of the proposed inspection area of 1,000 km^2 are shown on the map of Attachment 1. The area includes 35.2861N 165.1306E, the location of IDC Event 0654321. The error in positioning on IDC data is 11.8 km, the most plausible depth range is of 0 to 10 km. On IDC data the event took place at 22:32:12 GMT on 3 October 1998. Probable environment of the event is rocks deposited within the above depth range.
C. The area also includes 35.2200N 165.1892E declared by the State of Y as the place of chemical explosion detected as IDC Event 0654321. The assertion that it was the chemical explosion with the parameters specified in the Clarification of the State of Y that caused the seismic signal corresponding to the Event 0654321, is not in compliance with the IDC stated magnitude of body wave of 4.0 under any of the received models of its propagation in the area.

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D. IMS Infrasonic Station within the distance of about 340 km of the vicinity of Event 0654321 detected a signal which could be caused by the chemical explosion said in the Clarification of State of Y. However, the level of the infrasonic signal is close to that detected there earlier during the last year of sub-surface chemical explosions which was of about 100 TNT yield, as State of Y confirmed. Thus, the data of infrasonic monitoring do not agree with the information of the State of Y about the yield of the chemical explosion and cause further doubts that the detected seismic signal was generated by this chemical explosion.
E. Materials of the consultations and clarifications are fully provided in CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06 and CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07. The State of X considers it necessary to note that prior to Request for Clarification presented in CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06, the State of Y has not provided Technical Secretariat with any information on the national use of chemical explosion of the yield higher than 300 TNT as stated in Part III paragraph 2 of Protocol to the Treaty.
F. On available data, the State of Y has lately intensified the effort in its nuclear program causing concern about its potential weapon purpose. We know about the attempt undertaken at the end of 1977 to make the contact with "DUST" company on procurement of the dual-use equipment that could be used for producing weapon-grade fissile materials. The attempt was undertaken in diversion of effective international limitations and only the intervention of IAEA prevented from violation of the rules.
G. The State of X believes the above data related to the detection of the seismic Event 065431 are sufficiently ambiguous to warrant this On-Site Inspection Request to clarify whether a nuclear weapon test or other nuclear explosion has been carried out in violation of Article 1 of the Treaty.

Director-General forwards aforecited Request to the State of Y pursuant to Article IV.C. paragraph 49.

Remarks: None

End of CTBTO/DG/ODG/0001/1998/10/13/1400GMT/F08

Attachment 1
Map of the inspection area
<<see file MAP.GIF>>

Note: The inspection area is located in weak mountainous terrain, elevation changes up to 250 metres. There are no inaccessible places except for small swamps. Nearly whole area is covered with mixed forests. Map legend: blue – rivers and lakes, yellow – asphalt roads, grey and dashed black – dirt roads, bold black line – railroad, red – boroughs and buildings, purple – aerial power lines. The inspection area is a square with 31.5-km side.

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Form Number: F09

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: State of Y

Precedence: Immediate

Subject: Director-General Request for Clarification

Index: CTBTO/DG/ODG/0002/1998/10/13/1401GMT/F09

References:

1. CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06
2. CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07
3. CTBTO/DG/ODG/0001/1998/10/13/1400GMT/F08

Content:

Pursuant to Article IV.C., paragraph 42, of the Treaty, Director-General requests the State of Y to provide clarifications specified below in order to clarify and resolve the On-Site Inspection Request received from the State of X (Ref. A).

A. Provide explanations to resolve the conflict between magnitude of the seismic event detected as IDC Event 0654321 and declared yield of the chemical explosion which is the said event, as asserts the State of X.
B. Provide explanations to clarify the data of infrasonic monitoring mentioned in Ref. C in relation to the yield of the chemical explosions which were carried out, as the State of Y declared (Ref. B), in the vicinity of Event 0654321.
C. Provide explanations and other relevant information the State of Y would consider appropriate for clarifying other concerns on Ref. C including the items F and G of the reference.

Remarks: None

End of CTBTO/DG/ODG/0002/1998/10/13/1401GMT/F09

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Form Number: F10

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: All States Parties

Precedence: Immediate

Subject: Response to Director-General Request for Clarification

Index: CTBTO/DG/ODG/0003/1998/10/15/1733/GMT/F10

References:

1. CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06
2. CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07
3. CTBTO/DG/ODG/0001/1998/10/13/1400GMT/F08
4. CTBTO/DG/ODG/0002/1998/10/13/1401GMT/F09

Content:

At 16:27 GMT on 15 October 1998 the CTBTO received the following Response to Director-General Request for Clarification from the State of Y (Ref. D):

A. The State of Y already provided the Executive Council with the information on nature of the event detected by IDC as Event 0654321 in Reference CTBTO/EC/ODG/0002/ 1998/10/09/1300GMT/F07. The State of Y confirms that the sub-surface chemical explosion of conventional explosive with total yield of 500 tons TNT took place on 3 October 1998 at approximately 22:32 GMT in the vicinity of 35.2200N 165.1892E, in an open-cast mine.
B. We recognize the anomalous high seismic effect of the case in question. A nature of this anomaly is not completely clear and is at present under consideration of our experts. After completing the consideration relevant materials will be provided to the CTBTO. In this connection we would like to note that some other facts are known concerning the detection of the anomalous high seismic effect of chemical explosions, for instance, the results obtained in the course of joint US-Kazakhstan experiments carried out in July-September 1997 at the former Semipalatinsk Test Site.

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C. Weather conditions along the signal path may have affected the results of infrasonic monitoring. Unfortunately, there are no direct confident data on speed of wind and other conditions in the area that could be used for numerical estimates. In addition, the signal of the explosion in question, like the signals of earlier explosion, is rather weak and the measurement error is of great importance. Therefore, we believe that there is not any conflict between the parameters we provided of the chemical explosion and the data of infrasonic monitoring.
D. As it is known, within the framework of confidence-building measures providing Technical Secretariat with any information on the national use of the chemical explosions yielding higher than 300 tons TNT provided by Part III, paragraph 2, of Protocol to the Treaty is a voluntary measure. We consider groundless all the doubts about the above explosion, however, as the evidence of our readiness to cooperation with the Organization, we clarify that the explosion has not been notified in advance to avoid any preventing actions of the so-called environmental protection movement hampering this extremely important mining activity for the economy of the region.
E. We believe the Request does not concern in any way the problem related to the contract on procurement of equipment for producing fissile materials needed for our nuclear energy program which is being implemented in full compliance with our international obligations. We remind that in the arguable juridical situation our state voluntarily refused the contract and the problem was closed that was confirmed in an official IAEA declaration.

Remarks: None

End of CTBTO/DG/ODG/0003/1998/10/15/1733/GMT/F10

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Form Number: F11

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: State of Y

Precedence: Immediate

Subject: Notice of Inspection

Index: CTBTO/DG/ODG/0004/1998/10/15/2332/GMT/F11

References:

1. CTBTO/EC/ODG/0001/1998/10/07/1700GMT/F06
2. CTBTO/EC/ODG/0002/1998/10/09/1300GMT/F07
3. CTBTO/DG/ODG/0001/1998/10/13/1400GMT/F08
4. CTBTO/DG/ODG/0002/1998/10/13/1401GMT/F09
5. CTBTO/DG/ODG/0003/1998/10/15/1733/GMT/F10

Content:

Pursuant to Article IV.C., paragraph 55, Director-General forwards the following On-Site Inspection Notification to the State of Y:

INSPECTION MANDATE

A. Executive Council Decision: The Executive Council has resolved (with a vote of 47 members present = 31 affirmative/11 negative/ 5 abstentions) that the request by the State of X (Ref. C) is sufficiently justified and hereby approves the on-site inspection request to clarify whether a nuclear weapon test explosion or any other nuclear explosion has been carried out in violation of Article 1 of the Treaty and collect all the data which could help identify any potential violator.
B. State Party to be Inspected: State of Y.
C. Location of Inspection Area: 1,000 km^2 area including 35.2861N 165.1306E with boundaries in accordance with those drawn on the attached map (Attachment 1).

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D. Planned Types of Activity of the Inspection Team in the Inspection Area: At the initial step provided by Article IV.C., paragraph 47, all the activities specified in Part II.D., paragraph 69 (a) through (e), are planned except gamma-survey of the surface of the inspected area with radiation spectra analysis specified in (a). The inspection being continued as provided by Article IV.C., paragraph 47, as well as drilling being decided as provided by Article IV.C., paragraph 48, this item of the mandate is subject to relevant additions.
E. Point of Entry to be Used by Inspection Team: Airport "Alpha", State of Y
F. Transit and/or Basing Points: N/A
G. Head of Inspection Team:
Ifft, Edward Milton
H. Members of the Inspection Team:
  I. Filarowski, Christina A.
  J. Gough, Robert
  K. Hawkins, Ward Leslie
  L. Knowles, Cyrus Phillipp
  M. Kreek, Steven Andrew
  N. MacLeod, Gordon Avery
  O. Rockett, Paul David
  P. Russell, James William
  Q. Schroeder, Judith Kay
  R. Smith, Albert Turner, Jr.
  S. Sweeney, Jerry Joseph
  T. Wild, John Frederick
  U. Wohletz, Kenneth Harold
  V. Zucca, John Justin
  W. Dunlop, William Henry
  X. Antonucci, Daria Susan
  Y. Wolcott, John Heren
  Z. Scheinman, Adam Mark
  AA. Chi, Hans-Wolfgang
  BB. Evans, David Earl
  CC. Hardiman, Tara L.
  DD. Donnelly, Dorothy Carlson
  EE. Turnbull, Lawrence
  FF. Ray, Terrill Wylie

I. Proposed Observer: no

J. List of the Equipment to be Used in the Inspection Area: List of equipment for the initial step of the inspection is provided in Attachment 2. The inspection being continued as provided by Article IV.C., paragraph 47, as well as drilling being decided as provided by Article IV.C., paragraph 48, this item of the mandate is subject to relevant additions.
K. Date and Estimated Time of Arrival at Point of Entry: 19 October 1998, 09:00 Local.
L. Means of Arrival at Point of Entry: Flight ABC 1234.
M. Permanent number of diplomatic permission for non-scheduled flight: N/A

Director-General requests the State of Y to make available the equipment listed in Attachment 3 for the inspection team.

Director-General requests the State of Y to provide the inspection team with the following services, as stated in Part II, paragraph 11, of Protocol to the Treaty:

A. Hotel-like accommodations for all members of the team with standard services.
B. Heated offices with furniture (tables and chairs) of totally 100 square metres with electrical power (220 V, total power to 10 kW).
C. Heated workplace of 100 square metres with electrical power (220 V, total power to 50 kW) for equipment test and maintenance.
D. Stationary three meals and drinking water to standards.
E. Standard foodstuffs and water in portable containers for field feed.
F. Access to medical services, if necessary.
G. Suitable transportation for inspection personnel and equipment and required fuels and lubricants.
H. Interpretation services (2 interpreters educated in English and technical terms).

Remarks: Estimate 40 cubic metres (3,300 kilograms) of approved inspection equipment and personal baggage arriving with inspection team at the point of entry.

End of CTBTO/DG/ODG/0004/1998/10/15/2332/GMT/F11

APPENDIX II

U.S. SCENARIO CONSULTATION AND CLARIFICATION PACKAGE

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Form Number: F06

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: Pacifica

Precedence: Immediate

Subject: Request for Clarification

1. CTBT/OTS/1500/1427/2001/006/F06
2. **REFERENCE:** NONE
3. **CONTENT:** At 08:00 on 6 November 2001, the CTBTO received the following Request for Assistance in clarifying a matter of CTBT concern from Atlantia:

A. Pursuant to Article IV.C., paragraph 32, Atlantia requests the Executive Council to assist in clarifying a matter which causes us concern about possible noncompliance with the basic obligations of the Comprehensive Nuclear-Test-Ban Treaty by Pacifica.
B. On 1 November 2001 at 12:15, the International Monitoring System detected IDC Event 1614221, a 3.6 magnitude seismic event in the vicinity of 36.8217N166.3091W detected at a depth of less than five (5) kilometres.
C. Possibly related to this event, increased levels of ambiguous activity, including tunneling, has been detected, utilizing commercially available satellite imagery, at underground facilities in the vicinity of IDC Event 1614221.
D. Request immediate consultation and clarification with Pacifica to resolve this concern about possible noncompliance.

Remarks: None

End of CTBT/OST/1500/1427/2001/006/F06

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Form Number: F07

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: Atlantia

Precedence: Immediate

Subject: Response to Request for Clarification

1. CTBT/OTS/1510/1452/2001/008/F07
2. **REFERENCE:** CTBT/OTS/1500/1427/2001/006/F06
3. **CONTENT:** At 13:25 on 8 November 2001, the CTBTO received the following Response to the Request for Clarification from Pacifica:

A. In response to the compliance concern stated in the reference, the Government of Pacifica is currently investigating a possible source of IDC Event 1614221. An unintentionally large chemical explosion has been reported at a commercial surface coal mine at the same time and in the vicinity of the IDC Event. Initial reports indicate that personnel at this coal mine, located at 36.87N 166.30W, had planned a ripple-fire explosion in the course of routine mining activity, but for a currently unknown reason, inadvertently detonated all explosives simultaneously.

B. An additional possibility for the seismic event recorded as IDC Event 1614221 could have been an aftershock of the magnitude 4.1 earthquake that occurred in the vicinity (36.985N 166.230W) on 6 October 2001. (See IDC Event 1609923.) Pacifica possesses no regional seismic capability, and is therefore unable to confirm or refute this hypothesis.

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C. A local media report of the magnitude 4.1 earthquake is appended as Attachment One.
D. The current activity referred to in the Reference as "anomalous activity" is normal mining activity related to several commercial mines in the region.
E. Pacifica also draws attention to the fact that no other component of the IMS detected any evidence of noncompliance, including two Atmospheric Radionuclide Stations within 500 kilometres and an infrasound station within 300 kilometres of the area of IDC Event 1614221.

Remarks: None

End of CTBT/OTS/1510/1452/2001/008/F07

Attachment One

Capital City Tribune

8 October 2001

GOLD CITY: A moderate earthquake was felt by many city residents here on Saturday, although no injuries or significant property damage were reported. There were several reports of broken windows and dishes knocked from shelves. Seismologists at the National Earth Science Society in Capital City said the trembler registered a magnitude of 4.1 on the open-ended Richter scale and was centred in the Rhyolite Mountain area. Several long-time Gold City residents said this earthquake was one of the strongest in recent memory, although the area is known to frequently produce earthquakes in the magnitude 3 range.

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Form Number: F08

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: Pacifica

Precedence: Immediate

Subject: On-Site Inspection Request

1. CTBT/OTS/0325/1460/2001/009/F08
2. **REFERENCES:** A. CTBT/OTS/1500/1427/2001/006/F06
   B. CTBT/OTS/1510/1452/2001/008/F07
3. **CONTENT:** At 01:35 on 9 November 2001, the CTBTO received the following On-Site Inspection Request from Atlantia:

A. Atlantia has thoroughly analyzed the data provided in the Pacifica Clarification Response and deems it unsatisfactory.
B. Atlantia believes activities possibly associated with the detected seismic event are sufficiently ambiguous to warrant this On-Site Inspection Request to clarify whether a nuclear weapon test explosion or other nuclear explosion has been carried out in violation of Article I of the Treaty.
C. Pacifica's allegation in Reference B that either an inadvertent chemical explosion or an earthquake aftershock caused IDC Event 1614221 lacks scientific basis.

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D. A chemical explosion in a surface mine registering as a magnitude 3.6 event is highly unusual, even in a mining region that frequently uses blasting. Such an explosion would require a quantity of explosives far in excess of any known mining practices for this procedure. Additionally, the IMS infrasound station 300 kilometres away would have detected a surface explosion as large as the one claimed by Pacifica.
E. The Pacifica hypothesis that IDC Event 1614221 could have been an aftershock of an earthquake that occurred 26 days earlier is marginally credible. However, analysis of this event has determined that the first arrival was a sharp upward moving wave indicative of an explosive event and not resembling an earthquake or its aftershock.
F. The attached map of the proposed inspection area (Attachment 1) shows it as a 1,000-kilometre area that includes 36.8217N 166.3091W, the location of IDC Event 1614221.

Remarks: None

End of CTBT/OTS/0325/1460/2001/009/F08

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Form Number: F09

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: Pacifica

Precedence: Immediate

Subject: Director-General Request for Clarification

1. CTBT/OTS/0630/1462/2001/009/F09
2. REFERENCES: A. CTBT/OTS/1500/1427/2001/006/F06
   B. CTBT/OTS/1510/1452/2001/008/F07
   C. CTBT/OTS/0325/1460/2001/009/F08
3. **CONTENT:** Pursuant to Article IV.D., paragraph 42, of the Treaty, the Director-General seeks clarification specified below in order to clarify and resolve the On-Site Inspection Request received from Atlantia (Ref. C.):

A. Provide explanations and other relevant information in order to clarify the source of the seismic event known as IDC Event 1614221.
B. Provide explanations and other relevant information to clarify and resolve the ambiguities posed by the Requestor in Reference C.

Remarks: None

End of CTBT/OTS/0630/1462/2001/009/F09

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Form Number: F10

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: All States Parties

Precedence: Immediate

Subject: Response to Director-General Request for Clarification

1. CTBT/OTS/0550/1488/2001/012/F10
2. **REFERENCES:** A. CTBT/OTS/1500/1427/2001/006/F06
B. CTBT/OTS/1510/1452/2001/008/F07
C. CTBT/OTS/0325/1460/2001/009/F08
D. CTBT/OTS/0630/1462/2001/009/F09
3. CONTENT: At 04:05 on 12 November 2001, the CTBTO received the following Response to Director-General Request for Clarification from Pacifica:

A. Pacifica cannot offer "scientific" proof to back up our claim of an explosion at the coal mine since the region is seismically uncharacterized and we do not currently possess the technology to seismically monitor the region. Our investigation has determined the explosion was caused by human error. However, we can only offer the newspaper article, included as Attachment One, as further substantiation.

B. The lack of infrasound detection of the coal mine explosion is entirely feasible and readily explainable. The topography between the site of the explosion and infrasound station is uneven and, at the time of the explosion, rain showers were reported between these sites.

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C. As stated in Reference B, Pacifica reiterates that the activity in the area is wholly unambiguous and solely related to commercial mining activities.
D. While Pacifica understands how an unsanctioned and uncoordinated large chemical explosion could enhance the ambiguity of this event, the obvious commercial mining activities in the region by no means reflect evidence of a violation under Article 1 of the CTBT. Compliance with the Treaty is an obligation this nation takes extremely seriously.

Remarks: None

End of CTBT/OTS/0550/1488/2001/012/F10

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CTBTO
The Comprehensive Nuclear-Test-Ban Treaty Organization
Vienna International Centre, P.O. Box 1200, A-1400 Vienna, Austria. Tel: (+43-1) 21345 6200.
Facsimile: (+43-1) 21345 5898. E-Mail: Official_DGOTS@CTBTO.org.

Form Number: F11

FROM: Comprehensive Nuclear-Test-Ban Treaty Organization

TO: Pacifica

Precedence: Immediate

Subject: Notification of Inspection

1. CTBT/OTS/0105/1492/2001/013/F11
2. **REFERENCES**: A. CTBT/OTS/1500/1427/2001/006/F06
   B. CTBT/OTS/1510/1452/2001/008/F07
   C. CTBT/OTS/0325/1460/2001/009/F08
   D. CTBT/OTS/0630/1462/2001/009/F09
   E. CTBT/OTS/0550/1488/2001/012/F10
3. **INSPECTION MANDATE:**

A. Executive Council Decision: On 13 November 2001, the Executive Council resolved (with a vote of 46 members present = 32 affirmative/11 negative/3 abstentions) that the request by the requesting State party (Reference B) is justified and hereby approves the On-Site Inspection Request to clarify whether a nuclear weapon test explosion or any other nuclear explosion has been carried out in violation of Article 1 of the Treaty in the area specified in C. below. Coincident with the carrying out of this mandate, the inspection team shall transmit a progress inspection report to the Executive Council through the Director-General no later than 8 December 2001.

B. State Party to be Inspected: Pacifica.

C. Location of Inspection Area: 1,000 km 2 area including 36.8217N 166.3091W with boundaries in accordance with those drawn on the attached map (Attachment 1).

D. Planned Types of Activity: Those activities specified in Part II. D., paragraph 69 (a) through (e).

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E. Point of Entry: Capital City, Pacifica.
F. Transit or Basing Points: N/A.
G. Head of the Inspection Team: NOTIONAL.
H. Members of the Inspection Team: NOTIONAL 39-persons.
I. Proposed Observer: NOTIONAL.
J. Equipment to be Used: (From the Agreed-Upon List.).

4. **DATE AND ESTIMATED TIME OF ARRIVAL AT POINT OF ENTRY:** 15 November 2001, 08:35.
5. **MEANS OF ARRIVAL AT POINT OF ENTRY: National Airlines Flight 0977.**
6. **EQUIPMENT AND SERVICES REQUESTED THE INSPECTED STATE PARTY TO MAKE AVAILABLE TO THE INSPECTION TEAM:**

Hotel-like accommodations;
Office space with electrical power and heat;
Work area in inspection area for equipment checks and maintenance;
Xerox-type reproduction machine;
Required paper and assorted office supplies;
Food service and water with transportable potable water containers;
Access to medical services, if necessary;
Suitable transportation for inspection personnel and equipment;
34 12-volt automotive batteries;
Required fuels and lubricants.

Remarks: Estimate 400 cubic metres at 33,000 kilograms of approved inspection equipment and personal baggage arriving with inspection team at the point of entry.

End of CTBT/OTS/0105/1492/2001/013/F11

APPENDIX III

EXERCISE PLANNING, COORDINATION, DEVELOPMENT AND IMPLEMENTATION TEAMS

U.S. TEAM

Sponsor
Adam Scheinman, Office of Arms Control and Nonproliferation, DOE

Control Team Head
Christina Filarowski, LLNL

Control Team Members
Robert Gough, SNL
Ward Hawkins, LANL
Cyrus Knowles, DTRA
Steven Kreek, LLNL
Gordon MacLeod, NVOO
Paul Rockett, SNL
James Russell, NVOO
Judy Schroeder, OSD
Albert Smith, LLNL
Jerry Sweeney, LLNL
John Wild, LLNL
Kenneth Wohletz, LANL

Other U.S. Participants
Daria Antonucci, DOE/DynMeridian
Hans Chi, ACDA
William Dunlop, LLNL
Tara Hardiman, State Department
Edward Ifft, DTRA
Lawrence Turnbull, State Department

Interpreters
Pavel Oleynikov
Lada Talentova
Irina Zyryanova
Irina Malofeeva
Sergey Shatalov
Grigory Shkalikov

RF TEAM

Control Team Head
Vladimir Legon’kov

Other RF Participants
Vladimir Nogin
Vadim Smirnov
Yuri Sakharov
Valery Blyum
Vitaly Shchukin
Andrey Dubina
Mikhail Sakharov
Sergey Demjyanovski
Aleksander Petrovtsev
Valery Antoshev
Nikolay Ivashkin
Yuri Kaplan
Dmitry Sagaradze
Alexander Usachjov
Vladimir Tal’drik
Alexander Perevozin
Viktor Zaikin
Alexei Pchelin
Nikolay Kozeruk
Yuri Gvozdarev
Fedor Kripichev
Andrey Noskov
Ivan Nevraev
Vladimir Tyustin
Dmitry Moshkin
Vasiliy Tereshchenko
Evgeny Gorbachev
Yuri Sotnikov
Valery Savin
Anatoly Savinykh
Boris Lukishov
Arshak Ter-Semenov

Other RF Participants (Continued)

Yuri Khokhlov
Aleksander Nizamov
Yuri Popov
Vladimir Mokrousov
Igor Tyurin
Vladimir Drujinin