ON-SITE INSPECTIONS UNDER THE 1996 COMPREHENSIVE NUCLEAR TEST BAN TREATY (CTBT): TECHNICAL CONSIDERATIONS EDWARD IFFT

EFFECTS OF A NUCLEAR EXPLOSION RELATED TO ON-SITE INSPECTION (OSI)

The on-site inspection (OSI) aspects of the Comprehensive Test Ban Treaty (CTBT) focus on underground explosions, since this appears to be the most credible cheating scenario. The principal effects the inspection team (IT) would be looking for include seismic aftershocks as the "chimney" formed by the explosion collapses, radionuclides from venting, magnetic and electrical resistivity anomalies, environmental changes and other physical evidence related to a nuclear explosion. The latter could include subsidence, excavations, boreholes, pipes and wires. In general, it is very difficult or impossible to distinguish between a nuclear explosion and a chemical explosion by teleseismic means alone. OSI, however, can provide a "smoking gun" that a nuclear explosion did occur. Since false positives can occur with all four of the International Monitoring System (IMS) technologies (seismic, radionuclide, hydroacoustic and infrasound), OSI may also be able to provide convincing evidence that an ambiguous event is explained by something other than a nuclear explosion.

INSPECTION TECHNIQUES

An early activity of the IT would almost certainly be an overflight of the Inspection Area (IA), the size of which cannot exceed 1,000 square km. The Treaty specifies the details of this activity, whose purpose would be to allow the IT to gain general knowledge of the terrain and to identify features it would wish to inspect more closely on the ground. The IT would inspect areas of particular interest, identified in the Inspection Mandate, during the overflight or from other sources. A local seismic network may be installed to detect aftershocks. Multispectral imaging, including infrared measurements, are also allowed. Gamma-radiation measurements of air, soil and water samples would be used to detect radionuclides. Of particular relevance are four radionuclides of Xenon, with half-lives ranging from 9 hours to 11.9 days, which illustrates the need to get the IT to the site quickly. Although the Earth has a xenon background, an examination of the ratios of the abundance of individual xenon radionuclides can allow inspectors to distinguish between radionuclides generated by a nuclear explosion and those coming from other sources—e.g. reactors and production of medical isotopes. Another key gas of interest is Argon-37, which is formed by the interaction of neutrons from a nuclear explosion with calcium in the earth. This is more difficult to measure, but has a longer half-life of 35 days.

It should be noted that a cheater would presumably attempt to prevent any venting of radiation to the atmosphere. However, this is quite difficult, especially for a country without experience in nuclear testing. The U.S. and former Soviet Union used elaborate and expensive measures to prevent venting, but a significant percentage of underground tests did vent nevertheless. Xenon-133 from the 2006 North Korean test was detected by one IMS radionuclide station, but no radionuclides were detected from the test in May, 2009. Of course, there was no OSI for these events and there may well have been local radiation, which inspectors would have detected.

All of the above inspection activities are permitted during the first 25 days of the inspection (initial period). After this period—that is, during the continuation and extension phases, additional techniques may be used. These include resonance seismometry and active seismic surveys to search for underground anomalies, such as cavities and rubble zones. Other techniques in these later phases include magnetic and gravitational field mapping, ground-penetrating radar and electrical conductivity measurements. Finally, drilling to obtain radioactive samples—certainly a "smoking gun"—would also be allowed, although admittedly this would be an elaborate and expensive option.

The Inspected State Party (ISP) has the right to employ "managed access," a concept familiar in other arms control treaties, to protect sensitive sites. It can declare restricted access sites (RAs), but these may not be more than four square km in area, the total area of all designated RAs may not exceed 50 square km and there must be a separation of at least 20 meters between RAs.

INTEGRATED FIELD EXERCISE 08 (IFE08)

IFE08, carried out at the former Soviet Union's nuclear test range in Kazakhstan in August-September, 2008, was the most elaborate and realistic exercise of its kind to date. An obvious advantage of this location was the presence of real testing artifacts and real radiation. Over 50 tonnes of equipment were brought from Vienna and a full team of about 200 international inspectors, escorts

This is the second of two papers on CTBT OSI inspections by Edward Ifft and observers were housed in a tent city on the steppe, three hours from the nearest town. Operating under a scenario that suspicious seismic signals had been received by the IMS, along with possible release of Cs-137, a full inspection was compressed to five weeks. Most of the technologies noted above were successfully demonstrated. The ISP was generally cooperative, but did, by design, place impediments in the way of the IT, forcing it to improvise and devise alternative plans to carry out its work.

The exercise was designed to be a serious test of the logistics required for a difficult OSI in a remote location. As would be expected, problems were encountered—seals breaking in transit, problems with fuel, equipment and communications and severe weather (rain, snow, cold, high winds). Nevertheless, the IT functioned well with good morale and important lessons were learned. While far from demonstrating a worst case scenario, IFE08 provided a stressful and realistic test of the OSI concept. A thorough evaluation was conducted in Baden, Austria in December, 2008. IFE08 was a success and the lessons learned are being put into practice by the CTBTO. Further training and exercises are planned, aiming at a demonstration of operational readiness in 2012.

ASSESSMENT

It is difficult to give an accurate overall assessment of what the effectiveness of CTBT OSI will be, given that the regime is still being developed and it will probably be years before it is actually used. However, with the important proviso that data from the IMS and National Technical Means (NTM) are sufficient to define an Inspection Area that actually includes the location where the suspicious event took place, one can expect that there would be a high probability that a properly conducted OSI would identify any militarily significant nuclear explosion. In addition, the possibility of an OSI should have a powerful deterrent effect on any country contemplating cheating. Of course, there are certainly ways in which the Inspected State could make it difficult or impossible for the IT to carry out its mandate. However, such behaviour would become obvious over the course of 130 days and would itself be a violation of the Treaty.

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