THE INDIAN AND PAKISTANI TESTS: DID VERIFICATION FAIL?

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Trust & Verify

In the most intensive bout of nuclear testing since 1991, when the United States and France conducted 7 and 6 tests respectively, India and Pakistan between them detonated up to 11 underground nuclear tests in the month of May. To date these are the only nuclear tests conducted since the signing of the Comprehensive Test Ban Treaty (CTBT) in late 1996, which was intended to ban nuclear tests in all environments for all time.

India began the latest outbreak with purportedly three virtually simultaneous underground tests on 11 May, a feat accomplished previously only by the United States and the former Soviet Union, and a further two on 13 May. The first three were announced by the Indian government, after the event, as comprising a fission device (an 'atomic' bomb, fuelled by plutonium, of the Hiroshima variety), a thermonuclear device (a so-called hydrogen or H-bomb) and a 'low-yield' device. It was later reported that the thermonuclear device was in fact a technically less sophisticated 'boosted' fission device using tritium fuses to increase the yield of the explosion. All were conducted in the Pokharan Range in the northwest state of Rajasthan, where India's first test was carried out 24 years ago.

On 28 May Pakistan matched India's 'accomplishment' by detonating a reported five virtually simultaneous tests, followed by one more (originally believed to have been two) on 30 May. This purportedly brought Pakistan's total to six, the same as India if its May 1974 test is included, although there are some doubts as to the exact number of devices involved on both sides. All of the Pakistani tests were reported to be fission devices using highly-enriched uranium (U-235) and were conducted at its test site in the Chagai Hills in southwest Pakistan.

Apart from the serious implications of the tests for peace and security on the Indian sub-continent and the wider ramifications for international security, especially arms control and disarmament, the tests raised troubling questions about verification. In particular, did the tests demonstrate the failure of seismic and other means for remotely detecting and identifying nuclear explosions? If so, as some in the US Congress have suggested, is a CTBT then unverifiable?

Did verification fail?

While there would appear to be a prima facie case that the current monitoring systems under-performed in detecting and identifying the Indian tests, the conclusion that a CTBT is therefore unverifiable is simplistic.

In the first place, the 11 May series by India and both series by Pakistan were successfully detected and the location and source identified, and probably would have been even if an attempt had been made to conduct them clandestinely. The monitoring system, even in its nascent form, did, to that extent, work.

For the first Indian series—crucial because it was totally unexpected—seismic data were quickly available from the US-based Incorporated Research Institutions for Seismology (IRIS) global network group. Its stations are located worldwide from around 6 degrees epicentral distance from Pokharan (the station in Nilore, Pakistan) to some 90 degrees (stations in Canada) and further afield. The data showed a single event, originally estimated at magnitude 4.7, equating to a yield of some 20 kilotons (kt) of TNT, with an uncertainty factor of around 2.

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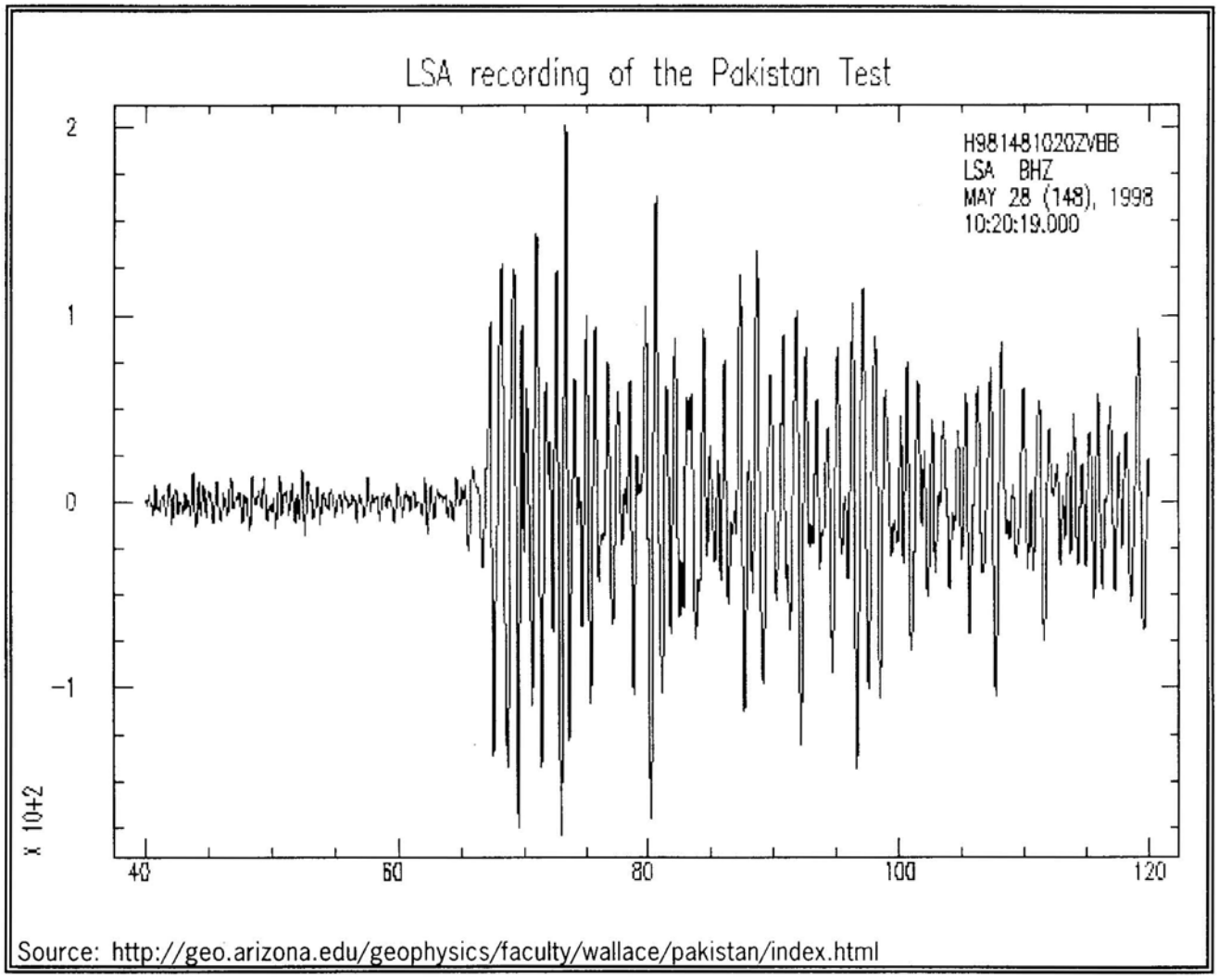

However the waveform of the event (as depicted on seismographs) was quite simple and not obviously derived from multiple sources, such as the double explosions conducted by the Soviet Union in the 1970s.

Eight days after the event the US Geological Survey, using more reliable seismic data from 125 stations, estimated that the 11 May explosions were:

- conducted at 10:13:42.0 Greenwich Mean Time (GMT)
- at a latitude of 27.102N and longitude 71.857E with depth constrained at zero kilometres, and
- with a body-wave magnitude of 5.2 and surface-wave magnitude of 3.6.

The estimated seismic location was 12 km from the actual location. The new magnitudes suggested a combined yield of 30-60 kt, consistent with the announced total yield of 56 kt. Hence the first Indian tests (and the later Pakistani tests) were detected by the seismic network and their location and approximate size determined, albeit not immediately.

Identification of the source of the events—whether a nuclear test or an earthquake—was more difficult. Based on so-called mb:Ms data (the relative size of two seismic wave types, which helps distinguish nuclear tests from earthquakes) and compared with a dataset of earthquakes in the Western United States and underground nuclear explosions at the Nevada Test Site, the 11 May event was clearly in the explosion population. In other datasets it was close to the separation between earthquake and explosion populations and was therefore ambiguous. This highlights the need for local calibration of both natural and man-made events in the Indian sub-continent.

Detection of separate signals for the purportedly simultaneous multiple explosions was even more problematic than identification of the source. Simultaneous explosions at the separation of the explosions cited in media reports (about 1 km) would give seismic signals separated by at most some 0.2 seconds or so. As this is much less than the dominant period (around 1 second) of each seismic signal, the combined signal would not obviously appear as two explosions, since they would overlap. A careful analysis of waveform

ta could perhaps detect the subtle variation in e signals, and thus the multiple sources of the May event, given sufficiently dense coverage by ismic stations. However this is by no means aranteed.

any event, while under a CTBT it might be eful to know how many clandestine explosions d been conducted simultaneously in order to termine the magnitude of a treaty violation, in fect such information is irrelevant to the fact of violation having occurred. Any explosion, gardless of its size or characteristics, would nstitute a violation.

contrast to the Indian tests of 11 May and the o Pakistani rounds, the performance of the ismic monitoring system in the case of the 'low eld' Indian test series of 13 May was troubling. o seismic data has been reported for these ents.

fficial Indian reports put the yields of the two plosions at 0.5 kt and 0.3 kt and the site(s) as ing 'in a sand-dune' (a rather unusual location if nting of radioactivity is to be avoided). A lly-contained explosion of the announced yields soft rock should have a magnitude of around 3, t be detectable by the most powerful stations, ch as seismic arrays. There was thus possibly me attenuation of the seismic signal because of e sandy nature of the test site. Seifs (linear nd dunes), in which the devices were reportedly ried, can reach 150 metres or more in height.

owever it has long been known that the seismic onitoring network for a CTBT would have fficulty detecting events below 1 kiloton because e constant movement of the earth's crust makes difficult to distinguish very small nuclear tests m small earthquakes. It has been assumed that newly proliferant country testing a nuclear apon for the first time would not be technically fficient enough to confidently detonate devices such low yields. India had 24 years to perfect technology of nuclear devices after its 1974 , while Pakistan has also been working on its lear weapon technology for decades and rtedly obtained blueprints from China.

econd reason why the tests should not be seen a demonstration of the failure of the rnational Monitoring System for the CTBT is it is still being established by the paratory Commission for the treaty. Indeed reaty itself has not yet entered into force.

64% of the primary seismic stations for the e network are currently functional and only of the secondary. These are not linked into nternational network in real-time and the ned International Data Centre (IDC) in Vienna is not yet in existence. A prototype IDC in Arlington, Virginia is being used. Delivery of both hardware and software to the Vienna IDC will begin this northern summer and the IDC is not expected to be fully operational until 1999 or 2000.

The non-seismic monitoring networks which will also contribute to CTBT verification are even less operational: only 27% of the hydroacoustic stations, 15% of the radionuclide and 2% of the infrasound stations are working. Radionuclide sampling and satellite imagery are significant if underground tests result in the venting of radioactivity and/or cratering. (If venting did occur during or after the recent tests it would be a violation of the 1963 Partial Test Ban Treaty (PTBT), which bans venting from underground tests and to which India and Pakistan are both party). Under a fully operational CTBT a state party would also be subject to challenge on-site inspections if suspicious events occurred.

Since a monitoring system the size and sophistication of that planned for the CTBT has never been created before, its synergistic capabilities remain unknown, although they are bound to be greater than the current fragmented, undeveloped one. While this concerns the verifiers, it should also give pause to potential violators of a CTBT.

A third reason why the verification system cannot be said to have failed in the Indian and Pakistani cases is that neither is party to the treaty or even a signatory. Neither has thus undertaken any legal obligation not to test nuclear weapons underground and neither has contributed to the international monitoring network, in particular by providing seismic stations. If India and Pakistan signed a CTBT they could be expected to contribute geophysical calibration data to permit better detection and identification of seismic events on the Indian subcontinent. But in that case they would probably not be expecting to attempt to violate the treaty. This is not to say that if India and Pakistan do not become a parties to the CTBT that the verification system will not be able to detect any future testing by them, but only that it will not be as easy.

A final reason why the May tests were not a good test of the system is that, except for the first Indian series, all the tests were expected and all detection systems, including so-called National Technical Means (NTM), were on high alert as to the possibility of events. US satellites detected the Pakistanis pouring concrete into their test shafts to seal them prior to detonation. Even the Indian first series were not a perfact test of the system's ability to detect and identify secret tests, since the Indians made no attempt to conceal the

fact that they had been conducted and, moreover, announced them.

The Failure of National Technical Means

The most surprising verification failure in the whole episode was not that of the nascent international monitoring system but that of so-called National Technical Means (NTM), a euphemism for all those means available to national governments to monitor each others' activities. In particular the United States' NTM, including its intelligence services, failed to detect Indian preparations for the first test series. In December 1995 US agencies did succeed in detecting test preparations and the Rao government was warned off from proceeding. But Indian preparations to test have been so longwinded—boreholes were dug in the 1980s—and the decision to test so long in coming that intelligence agencies were apparently lulled into complacency. In addition Indian scientists reportedly calculated windows of opportunity when American KH-12 satellites would not be over the Indian test site, permitting final preparations for the tests to go undetected. By the time the satellites did detect the preparations the tests had been conducted. (Under a fully operational CTBT regime, however, such post facto satellite imagery would be crucial in providing grounds for a challenge on-site inspection after a suspected event).

But high technology was not the only NTM available. The open political signs were there for all to see, including a declaration by Prime Minister Atal Bihari Vajpayee that India would now 'induct' nuclear weapons into its national defence. Admittedly even this was ambiguous, not necessarily implying a test program. Moreover, Indian politicians and scientists had for decades made ambiguous remarks about India's nuclear ambitions.

Conclusions

For verification the major lessons of the Indian tests are several: bring the CTBT into force and establish the international monitoring system as soon as possible, give the system as powerful a capability as possible and build in procedures to avoid complacency. Naturally the best outcome of all would be if, having gotten their nuclear tests off their metaphorical chests, both India and Pakistan were to sign the CTBT.

Trevor Findlay, *Executive Director, VERTIC, with technical input from* ***Roger Clark,*** *Lecturer in Geophysics, University of Leeds.*

BETTER LATE THAN NEVER: BIOLOGICAL WEAPONS VERIFICATION

Biological weapons (BW) may present the greatest threat of all weapons of mass destruction. They are arguably the easiest to acquire, have comparable effects to nuclear weapons and are subject to the weakest arms control regime. The 1975 Biological and Toxin Weapons Convention (BTWC), which prohibits the use of disease, whether against humans, animals or plants, as a weapon of war, lacks provisions for verifying compliance. The necessity of strengthening the BTWC is, therefore, evident.

The BTWC States Parties at a Special Conference in September 1994 established an Ad Hoc Group (AHG) with a mandate to consider measures to strengthen the BTWC and improve its implementation. The AHG commenced work in Geneva in 1995. In 1996 the AHG agreed to intensify its work and in July 1997 successfully transitioned to negotiation of a 'rolling text' of a BTWC protocol. All the essential elements for the Protocol are now in the rolling draft text, including mandatory declarations, non-challenge visits (both focused and random) and so-called compliance concern investigations, together with measures to strengthen the implementation of Article X on cooperation for peaceful purposes.. Although there is a proliferation of square brackets in the text indicating alternative language, this year has seen encouraging political developments that augur well for the successful completion of the work within the next twelve months.

First, the US reiterated in January that it seeks the completion of the framework of a strong BWC protocol by the end of 1998.

Second, the UK, in its role as President of the European Union (EU), announced on 9 March a common position that commits not only the EU Member States but also the 14 Associated Countries, a total of 29 States, to actively pursue decisive progress in the work of the AHG 'with a view to concluding the substantive negotiations by the end of 1998, so that the Protocol can be adopted by a Special Conference of States Parties early in 1999'.

Third, in March the Australian Minister of Foreign Affairs, in response to the recent crisis

between Iraq and the UN Special Commission (UNSCOM), proposed fast-tracking the negotiations on the BTWC by the convening of a high level meeting to inject into the negotiations the necessary political commitment to their early conclusion. Such a meeting may be held at Foreign Minister level in New York during the UN General Assembly session later this year.

However, a note of caution was sounded by the Non-Aligned Movement (NAM) and other countries at the end of the March 1998 AHG meeting. While confirming their commitment to the AHG and the strengthening of the BTWC, they noted that the decision of the Fourth Review Conference urging completion of the AHG negotiations as soon as possible enjoyed consensus support from all States Parties and hence that alternative time frames should be avoided. They also stressed that the mandate needs to be fully implemented and expressed their concerns at 'attempts to reduce the scope and importance of issues' related to Article X of the Convention (peaceful cooperation).

There is however, overall, a sense in Geneva of real purpose and seriousness in the negotiations. All the participating states are engaged in formulating consensus language to ensure removal of square brackets from the text.

The EU common position commits the 29 states concerned to working for the central measures of a strengthened regime, consisting of declarations of a range of facilities and activities of potential relevance, visits to facilities in order to promote accurate and complete declarations, rapid and effective investigations into concerns over non-compliance, together with a cost-effective and independent organization to implement the protocol effectively. It is encouraging that there is much common ground with the US position indicated in a White House Fact Sheet of 27 January 1998, which said the US will seek international agreement on declarations, voluntary visits, non-challenge clarifying visits and challenge investigations.

Although the common ground is encouraging, there are several details in the US position which would benefit from further consideration and modification. For instance, although the US favours *'voluntary visits...at the discretion of the facility concerned'* these are unlikely to be sufficient for the US in regard to any of the eight countries (Russia, Iraq, China, Syria, Iran, Egypt, Libya and Taiwan) which the US officially regards as being of concern with regard to BTWC compliance. There are circumstances in which voluntary visits could help to increase transparency and build confidence. For example, in visits to check declarations, a voluntary visit to other parts of the facility would be valuable. However, these should not be the only option.

As for challenge investigations, as the EU common position recognises, these need to be rapid and effective. The difficulties of conducting investigations some time after an alleged event were clearly shown in regard to the April 1997 Cuban allegation that *Thrips palmi* was dispersed from a US aircraft overflying Cuba. Furthermore, the US experience in the confrontation with Iraq earlier in 1998 showed the difficulties of building an international consensus even when the evidence was clear and internationally accepted. The US should recognise that there are good grounds for the BTWC having a similar 'red light' filter mechanism to that of the Chemical Weapons Convention (CWC), whereby a majority of states parties have to vote to stop an investigation (as opposed to a 'green light' procedure in which a majority of states have to vote to permit an investigation). As both the BTWC and the CWC rightly cover toxins, thereby ensuring no gap between the two conventions, it would not be beneficial for them to have two significantly different verification mechanisms.

The NAM statement shows a welcome commitment to the strengthening of the BTWC through the completion of the negotiations as soon as possible. They state that substantive progress in strengthening the application of Article X of the Convention is crucial to the conclusion of a universally acceptable protocol. These remarks appear to have resulted from moves at the March AHG meeting to constrain the scope of Article VII of the protocol; in the January draft it had the title 'Scientific and Technological Exchange for Peaceful Purposes and Technical Cooperation' with no square brackets, whereas the version resulting from the March meeting is '[Scientific and Technological Exchange for Peaceful Purposes] [Implementation Assistance] and Technical Cooperation'. This casts doubt on the intention of others to address that element of the mandate which requires the Ad Hoc Group to consider inter alia: 'Specific measures designed to ensure effective and full implementation of Article X, ...'

The particular importance of Article X measures to the developing countries is widely recognised. Although it is important to avoid duplication of activities taking place under other treaties and arrangements, such as those under Agenda 21 and the Convention on Biological Diversity, there are common goals in respect of international security, public health and environmental safety that can inform the work of the Ad Hoc Group to increase transparency and build confidence. In many countries, for public health and environmental

Meeting (TEM), involving an international panel of experts, held in September 1997 to consider Iraq's purported Final, Full and Complete Declaration of its biological weapons holdings and capabilities, concluded that the document was 'incomplete, inadequate and technically flawed'. As late as March of this year the Commission discovered a document, dated 1994, which indicated the existence of a program for the manufacture of nozzles for spray dryers to be delivered to Al Hakam, Iraq's principal biological weapons production facility.

Although UNSCOM Executive Chairman Richard Butler has said that UNSCOM's investigations could be concluded relatively quickly with full Iraqi cooperation, leading to the possible lifting of sanctions by the UN Security Council (although long-term monitoring would continue indefinitely), there is no indication that Iraq intends to offer such cooperation. UNSCOM, which was intended at its establishment in 1991 to be short-lived, is preparing for the long haul.

Georgian Nuclear Fuel Airlifted to Britain

On 22 April it was reported that the UK had accepted approximately 5 kilograms (kg) of weapons-grade highly-enriched uranium (HEU) fuel from Georgia. Although controversial in the UK, the move has clear non-proliferation benefits. It clears the way for Georgia to comply more readily with International Atomic Energy Agency safeguards, including the Additional Protocol which it had already provisionally applied. The HEU had been at Georgia's Institute for Physics just outside Tbilisi, where security conditions were less than ideal.

Small amounts of fissionable material require the same high security as larger amounts because of the risks of their being used for weapons purposes. Most of the HEU is in pure form and can be used for medical purposes: 0.8 kg was irradiated and will need to be reprocessed. It was estimated that at the end of 1994 there were 1,050 metric tons of weapons-grade HEU in the former Soviet Union (worldwide estimates were 1,770 tons). The Georgia case highlights the need for further intensive, co-operative international programs in fissile material protection, control and accountancy.

Compiled by Trevor Findlay and Suzanna van Moyland

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VERTIC News

Forthcoming Seminar on Indian and Pakistani Nuclear Tests

VERTIC will hold a seminar on the implications of the recent Indian and Pakistani nuclear tests, in cooperation with the Centre for Defence Studies (CDS), Kings College, London and the UK Council for Arms Control. The seminar will be held at the Council Room, King's College, on Thursday, 18 June from 10.00 am to 1.00 pm. Speakers will be Dr Chris Smith of CDS, Suzanna van Moyland of VERTIC and John Edmonds, former UK test ban negotiator and member of VERTIC's Board of Directors. Contact VERTIC for further details.

Getting to Zero Workshop

On 15 May VERTIC held a second workshop as part of its project on Verification of the Transition to a Nuclear Weapon-Free World and Sustaining the Verification Regime for an Indefinite Period ('Getting to Zero'). The two-year project, which ends in June, has been funded by the W. Alton Jones Foundation and the Ploughshares Fund. The 15 May meeting was attended by representatives of the Foreign and Commonwealth Office, the Ministry of Defence, Pugwash, the International Security Information Service (ISIS), VERTIC's Board of Directors and others. It examined in detail the four reports commissioned as part of the project.

The first, Verifying the Transition to Low Levels of Nuclear Weapons, by Patricia Lewis, covers the period in which the nuclear weapon states would be expected to cut their nuclear arsenals to the low hundreds. The second report, by Richard Guthrie, covers the period when complete nuclear disarmament—zero—is achieved and details the type of treaty and accompanying verification arrangements likely to be required. The third

report, by George Paloczi-Horvath, concerns what has been called 'virtual nuclear deterrence'. This refers to the existence of residual nuclear capabilities (such as skilled personnel, fissionable materials and general industrial capacity) which would give some states, especially former nuclear weapon states, the edge in any attempt to reconstitute nuclear weapons, thereby giving them a form of nuclear deterrence. The final report, by Suzanna van Moyland, concerns how to sustain the verification system for a nuclear weapon-free world into the indefinite future.

The four reports will be revised and completed by the end of May and published by VERTIC as research papers.

New Intern

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Verification Directory

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New Grant

In May VERTIC received a grant of US$30,000 from the John Merck Fund for a project on the verification and implementation of Comprehensive Nuclear Test Ban Treaty. The grant will enable VERTIC to conduct research into the issues facing the 1999 special conference of states parties to the treaty and to help contribute to that process.

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