International Data Centre

The International Data Centre (IDC) is designed to collect, process, analyse and report on data received from facilities of the International Monitoring System (IMS), including the results of analyses conducted at certified radionuclide laboratories. The data and products are then transmitted to States Parties for their final assessment. Data and products are received and distributed through the Global Communications Infrastructure (GCI).

The IDC is situated at the Headquarters of the Preparatory Commission in the Vienna International Centre. A relational database management system forms the core of all information management. Full network redundancy has been created at the IDC to ensure high availability. A mass storage system provides archiving capacity for more than 10 years of verification data. The software utilized in operating the IDC is mostly developed specifically for the CTBT verification regime.
PERFORMANCE TEST FOR THE COMMISSION

On 9 October 2006, the Democratic People’s Republic of Korea announced that it had conducted a nuclear weapon test. Though a clear action against the letter and spirit of the CTBT, the event provided an opportunity to demonstrate the technical capabilities of the verification system. It also provided an opportunity to test procedures in place and to highlight the added value that the system can bring to States Signatories in a situation of such political importance. Under the Treaty, after entry into force, IMS data and IDC products are provided to States Parties to enable them to draw their own conclusions. It is the prerogative of the States Parties to assess the nature of an event.

The event was well recorded throughout the world by the IMS. The signals from the event were detected at more than 10 primary seismic monitoring stations. Less than two hours later, States Signatories received the first automated data product, SEL1, containing preliminary information on the time, location and magnitude of the event. The IDC in Vienna expedited analysis of the seismic recordings and applied time lines for data processing and dissemination as envisaged in the Treaty. As a result, the PTS was able to distribute its primary data product, the REB, to States Signatories two days after the event. For the IDC waveform analysts, the event in the Democratic People’s Republic of Korea was just one of over 100 events that were included in the REB for that day.

The REB confirmed the validity of the event recorded in SEL3, and its location and time. Moreover, the inclusion of signal detections at one additional primary seismic station and a range of well distributed auxiliary seismic stations, together with the improvements associated with analyst review, reduced the uncertainty in the location to a possible inspection area of 880 square kilometres. This is well below the 1000 square kilometre maximum allowed for an on-site inspection under the Treaty (for more on this subject, see Preparing for On-Site Inspections).

Two weeks after the event, the radionuclide noble gas monitoring station at Yellowknife in the Northwest Territories, Canada, registered an unusually high concentration of xenon-133. Applying atmospheric transport models to backtrack the dispersion of the gas, its registration at Yellowknife was found to be consistent with a hypothesized release from the event in the Democratic People’s Republic of Korea.

At the time of the nuclear event on 9 October 2006, only 10 of the planned 40 stations with noble gas measuring technology were operating in test mode. The contribution of this technology to the analysis of the event demonstrated its significant role in the CTBT verification system. Recognition of the importance of noble gas technology became even more widespread in 2007 as a result, and the installation of additional noble gas systems in the IMS was expedited.

OPERATIONS CENTRE

The Operations Centre, as the focal point for operational activities, is a crucial part of integrated operations. It consists of control, escalation and multimedia rooms and is equipped with state of the art technology. From there, staff of the PTS are provided with a real time window on to the IMS. Activities of the centre include

HIGHLIGHTS IN 2007

• Testing of prototype state of health system initiated
• 31 stations introduced into IDC operations, raising the total to 219
• Almost 15 000 full-sample spectra automatically analysed, interactively reviewed and categorized
• Atmospheric backtracking exercise performed with the World Meteorological Organization
• First contributions of infrasound data to the Reviewed Event Bulletin for selected events.
FROM RAW DATA TO FINAL PRODUCT

The data collected by the IMS under provisional operations are processed immediately when they reach the IDC. The first automated data product, known as Standard Event List 1 (SEL1), is released within two hours of the arrival of raw data. This data product lists events recorded by the primary seismic and hydroacoustic stations of the IMS.

Requests are then made for data from the auxiliary seismic stations. The data from these stations, combined with the data from the infrasound stations and any late-arriving data, are used to produce the second automatic product (SEL2) six hours after the arrival of initial data.

This more complete event list, SEL2, is improved again after 12 hours have elapsed to incorporate any additional late-arriving data, to produce the final automated event list, SEL3.

Analysts subsequently review events recorded in SEL3 to prepare the Reviewed Event Bulletin (REB). During the current provisional operating mode of the IDC, the REB is targeted to be issued within 10 days. The draft IDC Operational Manual provides that, after entry into force, the REB will be released within approximately two days. The REB for a given day contains all those events which have been detected at IMS seismic, hydroacoustic, and infrasound stations and which meet specific criteria.

Observations from events recorded by IMS radionuclide particulate and noble gas monitoring stations typically arrive several days later than the signals from the same events recorded by the seismic, hydroacoustic, and infrasound stations. Radionuclide particulate data undergo both automatic and reviewed processing to produce an Automatic Radionuclide Report and then a Reviewed Radionuclide Report (RRR) for each full gamma ray spectrum received. The information in the REB and RRR will eventually be fused, associating seismoacoustic events with radionuclide detections.
status reporting, operational incident management, and GCI data, network and systems operations. Over four thousand incidents were registered and resolved in the centre in 2007.

The main tool employed in the Operations Centre in its day to day operations is the System-Wide Incident Tracking System (SWITS), which provides a single interface for reporting and tracking all types of incident. Another key tool is the state of health (SOH) system. A prototype SOH tool, which provides the Operations Centre staff with a consolidated view of the relevant incident troubleshooting metrics, has been developed and is undergoing operational testing.

**PROCESSING WAVEFORM AND RADIONUCLIDE DATA**

In 2007, support and build-up of the IMS continued with testing and evaluation of data from new stations. Thirty-one newly installed or upgraded stations were introduced into IDC operations, which increased the total number of stations in operations to 219. Fourteen stations were installed in the IDC test bed.

For the first time, infrasound data were introduced into the REB for selected events. Though not yet connected to network processing, a new analyst procedure for smoothly introducing infrasound data was proposed and tested. New interactive review tools were also introduced or enhanced to facilitate the operational work of the IDC infrasound specialist group.

**Waveform Data**

Standard IDC products were issued for each day in 2007. On average, 126 events per day were included in the automatic SEL3 and 80 events per day in the REB, compared with 122 and 76 respectively during 2006. Deficiencies in data processing software were identified, enhancements were proposed and software upgrades were tested and evaluated. In addition, data were forwarded to recognized tsunami warning organizations (see “Tsunami Early Warning Systems” at the end of this section).

**Radionuclide Data**

During 2007, 14,879 full-sample spectra were automatically analysed, interactively reviewed and categorized. Of these, 10,606 were Level 1 spectra (containing normal natural nuclides). Four spectra were categorized as Level 5 (containing multiple anthropogenic nuclides and therefore Treaty-relevant), and the respective samples were sent for reanalysis to cer-
tified laboratories in accordance with standard procedures. In addition, 57 samples which were not Level 5 were sent for reanalysis to laboratories for quality control purposes.

ASSESSING QUALITY OF FINAL PRODUCTS

Performance monitoring activities concerning the quality of IDC products continued in 2007 by comparing the REB with the bulletins from the International Seismological Centre (ISC) for the year 2004 and the National Earthquake Information Center (NEIC) of the US Geological Survey for the years 2005 and 2006. These assessments measure the accuracy and completeness of the IDC bulletin relative to the most comprehensive data sets available for global seismic event locations. Though the IMS seismic network is not yet complete, the assessments confirmed the current high quality of IDC products.
A National Data Centre (NDC) is an organization with technical expertise in the CTBT verification technologies working under the guidance of a National Authority. Its functions may include sending IMS data to the IDC and receiving data and products from the IDC.

The ‘NDC in a box’ is a software package developed by the IDC for use at NDCs, giving them the capability to receive, process and analyse IMS data. By the end of 2007, this software had been distributed to more than 100 States Signatories. The software package was made available to States Signatories through the IDC secure web site.

By the end of 2007, 97 secure signatory accounts (one for each requesting State Signatory) had been established and a total of 859 users from these States Signatories had been authorized to access IMS data and IDC products and receive technical support. This is an increase of more than 50 over the number of users in 2006. More than 1000 requests from authorized users regarding technical information were received and resolved during the year.

**NATIONAL DATA CENTRES**

A National Data Centre (NDC) is an organization with technical expertise in the CTBT verification technologies working under the guidance of a National Authority. Its functions may include sending IMS data to the IDC and receiving data and products from the IDC.

Still to be registered (80)

Secure Signatory Accounts of States Signatories at the End of 2007

<table>
<thead>
<tr>
<th>Region</th>
<th>Accounts</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa (11 of 20)</td>
<td>18.0%</td>
<td></td>
</tr>
<tr>
<td>Middle East and South Asia</td>
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<td></td>
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<tr>
<td>North America and Western Europe</td>
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<tr>
<td>Europe (18 of 23)</td>
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<td></td>
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<tr>
<td>Latin America and the Caribbean</td>
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<td></td>
</tr>
<tr>
<td>South-East Asia, the Pacific, and the Far East</td>
<td>13.0%</td>
<td></td>
</tr>
</tbody>
</table>

Percentage of Users of IMS Data and IDC Products by Geographical Region at the End of 2007

<table>
<thead>
<tr>
<th>Region</th>
<th>Users</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa (18 of 51)</td>
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<td></td>
</tr>
<tr>
<td>Middle East and South Asia</td>
<td>35.0%</td>
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<tr>
<td>North America and Western Europe</td>
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<td></td>
</tr>
<tr>
<td>Europe (18 of 23)</td>
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<td></td>
</tr>
<tr>
<td>South-East Asia, the Pacific, and the Far East</td>
<td>35.0%</td>
<td></td>
</tr>
</tbody>
</table>

**NOBLE GAS PROJECT**

Special noble gas detection systems have been developed and are currently being deployed in the IMS radionuclide network. A plan was approved by the Commission to integrate this new technology into its routine data processing. In June, distribution to interested States Signatories of raw data from the first 14 stations to have noble gas systems installed began. In October, distribution of automatic analysis results began for testing purposes. (To understand the important role that noble gases play, see *International Monitoring System: “Noble Gases”*.)

Distinguishing the civil anthropogenic background level of airborne radionuclides from radiation emissions due to Treaty-relevant events is a challenging task that involves nuclear physicists, statisticians and meteorologists. The PTS is currently putting emphasis on obtaining a comprehensive understanding of possible sources, atmospheric transport and variability of the noble gas radioxenon over time. This is possible through cooperation with scientists from more than 20 institutions worldwide in the International Noble Gas Experiment (INGE).

In June 2007, the European Union approved a joint action to support PTS research activities to explore the anthropogenic xenon background and to fund a PTS field campaign for studying and measuring the xenon background in several parts of the world. The results gained during the last eight years from INGE have clearly shown that the radioxenon background is
much more complex than was initially thought. Indeed, initially unforeseen anthropogenic sources have been identified, such as radioisotope production facilities for medical applications.

**TRACKING RADIONUCLIDES THROUGH THE ATMOSPHERE**

Early in 2007, following a significant period of scientific and technical cooperation, the Executive Council of the World Meteorological Organization (WMO) approved the inclusion of the CTBTO–WMO response system in its Global Data Processing and Forecasting System. In the third quarter of 2007, the PTS formally approached the WMO Secretariat to nominate Regional Specialized Meteorological Centres for atmospheric backtracking.

Atmospheric backtracking is the method applied by the PTS to resolve, to the best possible extent, the ‘field of regard’ of Treaty-relevant (Level 5) radionuclide detections by the IMS. This method also provides the possible source regions associated with a scenario of such detections. The specialized WMO centres are the authorized external institutions that would attend to PTS requests for support in such Level 5 cases.

**ANTALYA ATMOSPHERIC BACKTRACKING EXERCISE**

As part of a group of small scale focused tests, the PTS performed an atmospheric backtracking exercise with WMO centres based on a seismic event, recorded by the PTS, 90 km south-west of Antalya, Turkey, on 2 December 2007.

Atmospheric transport modelling software developed by the PTS predicted which stations would be affected by radioactive debris assumed to be released from

The radioxenon background is much more complex than initially thought and originates from different types of civil source releasing xenon isotopes into the atmosphere. The chart compares a typical daily source strength against what is produced by an atmospheric nuclear test with a 1 kt yield.

Data Fusion Bulletin (template) issued daily by the PTS throughout the exercise to communicate interactive source location and data fusion results to States Signatories.
the location in Turkey. The hypothetical radioactive samples were treated as Level 5 radionuclide detections, and nine WMO centres were subsequently requested to support the PTS with atmospheric backtracking results in near real time. These centres were located in: Beijing, China; Exeter, United Kingdom; Melbourne, Australia; Montreal, Canada; Obninsk, Russian Federation; Offenbach, Germany; Toulouse, France; Washington, D.C., USA; and Vienna, Austria.

Afterwards the results were analysed by the IDC and, for the first time ever, a daily Data Fusion Bulletin combining waveform and radionuclide data was produced. During the experiment it was possible to narrow down the possible sources to three events occurring on the same day and only 150 km apart. Throughout the exercise, neither the WMO centres nor the IDC data fusion specialists knew which event had been selected as the mock source.

The CTBTO–WMO response system is an excellent example of how the harmonization of computational and development efforts of WMO meteorological centres and the PTS in the area of atmospheric transport modelling is serving to benefit both organizations and their member States.

**TSUNAMI EARLY WARNING SYSTEMS**

Following the tragedy caused by the tsunami in the Indian Ocean in December 2004, the Commission tasked the PTS to test the provision of data for the purpose of tsunami warning.

A number of tsunami warning institutions began receiving IMS data in near real time on a test basis. During this test phase, which lasted over a year, tsunami warning centres confirmed the usefulness of IMS data. In comparison with data from other existing monitoring networks, IMS data were found to arrive at these tsunami warning centres with less delay and higher reliability. This provides potentially vital additional warning time in which to activate alerts in the event of a possible tsunami threat.

Consequently, in November 2006, the Commission endorsed a recommendation to provide continuous data in real time to relevant tsunami warning organizations. Four tsunami warning centres currently receive data from about thirty IMS stations. These centres are located in Australia, Japan, Malaysia and the USA (Hawaii).

While the purpose of the global verification regime is to verify compliance with the CTBT, the use of IMS data to mitigate the catastrophic consequences of tsunamis is an example of the wide range of potential civil and scientific applications for which these data could be used.