Verification highlights

IMS station installation in Kamchatka: A challenging mission to one of the remotest places on earth

The Kamchatka peninsula is situated in the far east of the Russian Federation, nine time zones from Moscow. It occupies an area of more than 470,000 square kilometres, the combined size of Germany, Austria and Switzerland, with only 400,000 inhabitants. Due to its location on the north-western edge of the Pacific ‘ring of fire’, which is formed where the Pacific Plate collides with other tectonic plates, Kamchatka developed a landscape of exceptional natural beauty, consisting of more than 400 glaciers and 160 volcanoes, 29 of them still active, geysers and natural thermal springs, remote lakes, wild rivers, impressive mountain ranges and a spectacular coastline.

Until the early 1990’s, Kamchatka was closed to foreigners and even most Russians, due to its strategic importance and the substantial military presence on the peninsula: Kamchatka is home to the Russian Pacific Submarine Fleet, has several major airbases and is an important testing ground for Inter-Continental Ballistic Missiles. While Kamchatka was shrouded in military secrecy, its animal population was left to flourish: The peninsula contains great species diversity, including the world’s largest variety of salmon and the densest population of brown bears in the world. The bears, which reach an enormous size of up to three meters in length and 1000 kg in weight, live all over the peninsula.

In October 2005, two staff members of the Provisional Technical Secretariat (PTS) returned from a four week mission in Kamchatka, where they supervised and coordinated the installation work for primary seismic station PS36 and
infrasound station IS44, located in a military base some 100 kilometres from Petropavlovsk-Kamchatsky, the regional capital. The 30 installation team members consisted of Russian and Canadian specialists with different backgrounds, reflecting the complex contracting situation of the project.

The installation of these two International Monitoring System (IMS) stations is a landmark achievement in the entire process of establishing IMS stations in the Russian Federation. The preparatory work, which included design and execution of the site preparation, complex equipment procurement and other logistical, technical and administrative processes, stretched over five years.

The two co-located arrays required massive site preparation activities for the installation of the well-designed and built vaults, robust and modern radio antenna towers and state of the art central recording facilities. The site preparation activities were particularly challenging due to the harsh environment and the short summer, the only time of the year when such work could be carried out.

The project was also complex because of the different types of equipment – seismic, infrasound, communications and computer equipment – which needed to be procured from different suppliers in all three fields. The seismic and the digital parts of the infrasound equipment were delivered from Canada, the microbarometers from France, and the Canadian built communications and computer equipment was supplied from Moscow. Some smaller items were provided directly by the PTS. Integrating and assembling these various system components in the field required intensive preparation by the PTS staff members prior to the mission.

For hands-on training and for facilitating the completion of the first stage of the installation, the PTS team received support from two officers of the Special Monitoring Service, which is part of the Russian Ministry of Defence. The officers, graduates from the military academy with specialization in seismic monitoring, successfully installed the seismometers and digitisers in the vaults.

The PTS team was cut off from material and food supply for four days when a series of explosions in a naval ammunition depot on 1 October, located half way between the installation site and the accommodation of the PTS team, caused the continued on page 23
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Development of noble gas equipment for OSI purposes

Radioactive noble gas (RNG) isotopes are the only radioactive elements that are likely to escape into the environment from a well-contained underground nuclear explosion. Therefore they play an important role in the different verification aspects of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), particularly in the case of an on-site inspection (OSI).¹

During an OSI, RNG isotopes are measured based on considerations of yield (enough activity must be produced) and life time: The isotope in question must be long-lived enough to allow detection days or weeks after an event, and short-lived enough not to cause a continuous build-up of ambient background activity from various innocuous sources. Most isotopes fail either or both of these tests, but for OSI purposes four isotopes of xenon (131mXe, 133mXe, 133Xe and 135Xe) and one isotope of argon (37Ar) are of relevance. The xenon isotopes are fission products or are produced in the decay of fission products, while 37Ar is produced by high-energy neutron activation of calcium.

The development of RNG measurement equipment suitable for OSI purposes involves the production of mobile versions of xenon sampling and analysis systems and the adjustment of these systems to OSI-specific challenges, such as mobile field operations taking place under time pressure, potentially limited supplies of power, spare parts and repair facilities, and possible lack of transportation and trained personnel. Significant progress has been made in the re-engineering of RNG measurement equipment with the support of the Preparatory Commission, based on equipment designed for International Monitoring System purposes.

Furthermore, a crucial capability envisioned for an OSI system is the analysis of sub-soil gas samples. This task entails a limitation in available sample size which is not present in atmospheric sampling as well as a sample composition which is radically different from that of an atmospheric sample.

The development of the capability to detect the noble gas isotope 37Ar is unique to the OSI application. This isotope has a considerably longer half-life than the CTBT-relevant radio-xenon isotopes, and would so be more likely to remain in detectable quantities during the time-frame of an OSI. On the other hand, stable argon comprises an enormously larger fraction of standard air than does xenon, potentially resulting in unwieldy sample sizes once the chemical separation is accomplished. In addition, the determination of the sample activity is complicated by the very low energy of the emitted ionizing radiation.

These difficulties could be mitigated by off-site measurement of samples in a designated laboratory – such a solution would be more profitable in the case of 37Ar than in the case of the radio-xenons due to the longer life-time of the former. Consequently, Provisional Technical Secretariat support to mobile argon sampling development by one Member State institution is complemented by support to another Member State institution to establish the capability for high-sensitivity laboratory measurements of samples collected on-site. This will also allow inter-comparison measurements with independent methods, an approach which has proven useful in the development of RNG analysis for the International Monitoring System.

¹An OSI clarifies whether a nuclear explosion has taken place in violation of the Treaty and gathers facts which might assist in identifying any possible violator. It can only be carried out, with the approval of the Executive Council, once the Treaty has entered into force.
Cross-divisional O&M coordination of the verification system

As the construction of the monitoring system advances, the task of provisional operation and maintenance (O&M) becomes ever more important. Since 2003, the Provisional Technical Secretariat (PTS) has been performing provisional O&M under more relaxed guidelines for data availability requirements than those expressed in the draft International Monitoring System (IMS) and International Data Centre (IDC) Operational Manuals which provide standards for performance following entry into force of the Treaty. The Commission has approved the continued application of these relaxed guidelines until the end of 2006. Nevertheless, processes and procedures must be designed, tested and practised so that the standards envisaged after entry into force can be met.

The provisional operation of the monitoring system involves generation of data at the IMS facility, data transmission to the IDC in Vienna, receipt and storage of data, automatic and interactive processing of data to create bulletins, and, finally, distribution of data and products to States Signatories. In order to be successful, this activity clearly requires the coordination of many different actors.

In March this year, the PTS established a cross-divisional Operations Centre which provides centralized monitoring and support functions for operation and maintenance of the verification system. It is currently located in temporary premises until completion of the outfitting of a permanent location which will enhance effectiveness and visitor access. This Operations Centre enables the efficient detection and resolution of incidents that affect operation, whether they occur at a remote location or at the Headquarters in Vienna. For more complex cases, after incident detection in the Operations Centre, the problem is referred to the appropriate party for resolution.

The PTS is continuing to develop the unified tools and processes to record and track problems in the verification system and to monitor its state of health. An incident tracking tool supports a mechanism to open an incident report on any and every data outage and to track the incident until resolution. A system for monitoring state of health provides status information on a wide variety of hardware and software items at remote facilities and at Vienna Headquarters. As an added advantage, the tools and processes at the Operations Centre generate O&M statistics which can be used to assist in the elaboration of policies to enhance performance and optimize costs.

In performing the above tasks, various Divisions of the PTS collaborate to achieve the goals set for the PTS. Further, many of the actors are external to the PTS, such as station operators (designated by the host States), other State institutions as well as contractors to the PTS. The work of all of these actors needs to be successfully coordinated in order to produce optimum results.