ISTITUTO DI SCIENZA E TECNOLOGIE DELL'INFORMAZIONE "A. FAEDO"

Annuncio di Seminario

USPID-ONLUS

Mercoledì 27 maggio 2015 – Aula A 27 - Area della Ricerca CNR – Pisa - ore 11

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Modello di Trasporto Atmosferico dello Xenon radioattivo: studio dell'impatto ambientale delle Centrali Nucleari e analisi degli eventi critici per la Comprehensive Nuclear-Test-Ban Treaty Organization

ABSTRACT

The CTBTO (www.ctbto.org) was established in 1996 to build up the verification regime of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), to ensure its completion by the time the Treaty enters into force and to promote the Treaty's universality. The verification regime of the CTBT is based on the three mutually-reinforcing pillars – the International Monitoring System (IMS), the International Data Centre (IDC) and provisions for On-Site Inspections (OSI) – and is designed to detect any nuclear explosion conducted on Earth – underground, underwater or in the atmosphere. Particularly, the IMS consists of 321 monitoring stations and 16 laboratories built world wide. These 337 facilities monitor the planet for any sign of a nuclear explosion using four complementary verification methods: seismic, hydro-acoustic and infrasound stations monitor the underground, the large oceans and the atmosphere respectively; radionuclide stations detect radioactive debris from atmospheric explosions or vented by underground or underwater nuclear explosions.

Many gigabytes of data are transmitted every day – from the monitoring stations to the IDC – and the Operations Centre at the CTBTO monitors all data traffic which includes incoming data arriving via satellite links from the stations, automatic data processing, as well as data dispatched to Member States; any failure in data transmission is analyzed and a troubleshooting process is initiated to address the situation. The computer center houses over 200 servers with disk storage capacity of over 100 TB for verification related data processing. In addition, a Mass Storage System of comparable storage capacity is employed to archive all Treaty verification data. New features include radionuclide analysis software, Atmospheric Transport Modeling (ATM) and live measurement of incoming station data, currently around 10 GB/day.

Then the IMS, which is currently built up by the CTBTO, continuously takes environmental measurements including atmospheric concentrations of several radionuclides. The characterization of the existing and legitimate background, which is produced mainly by Nuclear Power Plants (NPPs) and Isotope Production Facilities (IPFs), is of high interest to improve the capabilities of the monitoring network. Over 400 reactors at NPPs are currently in operation worldwide, while only five IPFs are considered to be continuously emitting relevant activity levels. Nevertheless, the emission strengths of typical nuclear power reactors are below the emission strengths of these IPFs; a typical IPF usually emits radio-xenon in the order of magnitude or above the total of all operational NPPs together. Therefore, the long-term global radio-xenon background is a result of many weak and a few strong sources.

The emissions from legitimate sources can usually only be estimated. However, historic source terms of 133-Xe emissions from the IPF at ANSTO, Sydney (Australia), have been made available in a daily resolution, and then applied together with ATM to predict the concentration time series at two radio-xenon monitoring stations: Melbourne (Australia) and Chatham Island (New Zealand).

Moreover, following the Fukushima NPP accident, detections of 133-Xe have been made in various locations. Using results of these remote measurements, the Fukushima 133-Xe source term has been reconstructed and compared with previously estimated 137-Cs and 131-I source terms.

Finally, the CTBTO has emphasized how monitoring data can support disaster mitigation efforts, for example by helping tsunami warning centers to issue more timely warnings or by monitoring airborne radioactivity after nuclear accidents. This was well recognized by the United Nations General-Secretary, Mr. Ban Ki-moon, who stated in his video address to participants attending the CTBTO's Science and Technology Conference in June 2011 "Even before entering into force, the CTBT is saving lives".

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