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Implementation of New Technologies at IMS Radionuclide Particulate Stations

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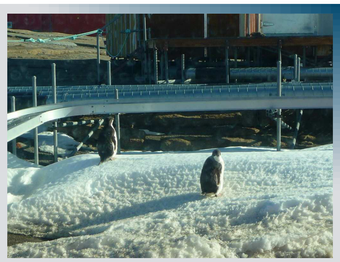
MRP43 - Mauritania (Sand protected air sampler)

Abstract

Sixty-nine of the 80 CTBT IMS particulate stations are already installed of which 66 are certified. Some of these stations are situated in very remote locations, and operational conditions often include very harsh climate conditions and constrained infrastructures. In order to improve data availability and quality for these stations and also to sustain long term operations, the IMS division is developing and implementing state of art solutions which decrease the stations susceptibility to these harsh external conditions. This poster describes the latest technological solutions, some already implemented or soon to be implemented at IMS radionuclide particulate stations, to provide improved reliability, redundancy, and data quality.



AUP05 - Mawson (Outside the station)

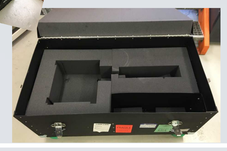
High resolution Germanium Detectors Hardening

Ruggedized HPGe detector solutions optimized for use at IMS stations have been identified and finalized in collaboration with R&D department of detector providers, and three different units are at present in testing phase at CTBTO test station VIP00 – on rooftop of the Vienna International Centre, in Vienna. Detectors under testing implement full metal seals hardened endcap and cryostat, and/or hardened vacuum and warm cycle free cryostats,

Ultra high vacuum cryostat & warm cycle free

Flanged endcap & full metal seals

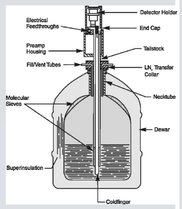
Also hardened transport boxes have been engineered by providers in close collaboration with PTS staff, tailored to minimize the impact of shipment to sometimes remote and/or logistically difficult IMS stations, but also aiming at easier and safer handling by operators.



LN2 based Cooling Solutions

Four different detector cooling options making use of LN2 are validated and in use at IMS stations, and one additional option is under engineering from a new provider:

- **Standard LN2 30 liters dewar (in use)**
  - requires regular external LN2 refill – almost troubleshooting free, with no station downtime



- **CTBT-ELAN3 Liquid Nitrogen generator (in use)**
  - allows offline troubleshooting and external LN2 refill in case of issues, with no station downtime

- **CryoCycle-II and Moebius non-modular Hybrid Cooling Systems (in use)**
  - both allow external LN2 refill in case of issues but not offline troubleshooting

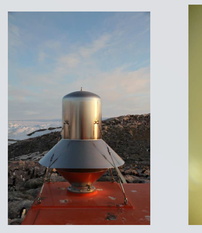
- **Nicole modular Hybrid Cooling System with removable Cryocooler (engineering phase)**
  - Will allow removing cooling motor for offline troubleshooting and external LN2 refill in case of issues, with no station downtime

Hardened Air Sampler Solutions

Harsh weather conditions at some RN stations (high wind speeds, high snow fall, rain drifts, frequent accretion of atmospheric ice) created the need for modifications to the standard air sampler. Some of the implemented solutions include:

- Integration of filter holder unit and all electronic devices inside a special container in order to enable indoor filer change
- Special design of the inlet head to minimize the risk of snow clogging
- Filter heating to dry the filter from snow or rain
- Heating to reduce humidity intake at the inlet pipe of a RASA system

Insertion of inlet tube heating DEP33 (RASA)



Inlet head Dumont d'Urville FRP32

Sampler Room Mawson AUP05

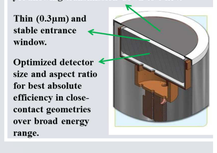
Filter heaters inside the filter chamber St. John's CAP17

Enhanced Calibration Methods

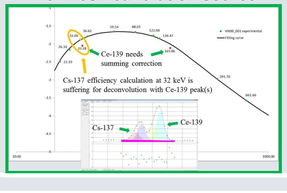
Advances in semi empirical calibration software and methods, together with challenges in procuring and delivering radioactive sources to several IMS stations, triggered development by PTS radionuclide experts of alternative, more efficient, flexible and cost effective approach that could be use for IMS stations calibration.

Evolution of HPGe detectors in use at IMS stations (planar detectors with thinner dead layer and carbon-epoxy cryostat window) results in lower Compton contribution and higher efficiency (improved MDAs) at low energies, but also in increased summing effects; careful selection of calibration nuclides and enhanced summing correction techniques are required in order to ensure accuracy of results in spectra analysis.

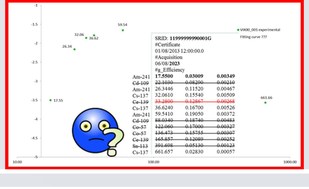
Enhanced use of semi-empirical methods in supporting experimental calibration, already implemented at IMS stations, would provide full control of efficiency calibration even in difficult conditions, when dealing with aged sources.



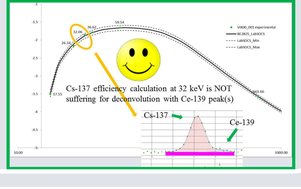
Experimental calibration with fresh calibration source



Experimental calibration with >10 years old calibration source

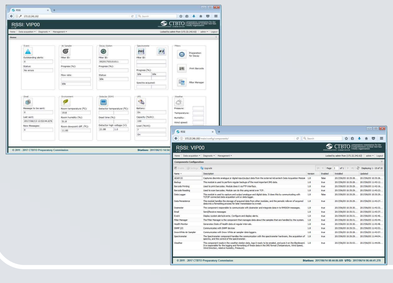


Semi empirical calibration with >10 years old calibration source



New Radionuclide Station Software (RSSI)

The development of a modern Radionuclide station software interface (RSSI), together with enhancement in general features, grants full SW maintainability and OS independency.



- ✓ Web based (simple remote access)
- ✓ OS independent
- ✓ User-oriented design
- ✓ Python programmed (easy to change, modular)
- ✓ Two-detector support included
- ✓ Communication to devices via Ethernet
- ✓ Full support for IMS2.0 Command&Control
- ✓ ESDSA signature support

Redundancy of Detector Systems at IMS Stations

Installation of twin detector systems in "hot spare" configuration at remote or logistically difficult IMS stations are ensuring Data Availability in case of main detector system failure.

The objective is zero station downtime in case of main detector system failure, with near real time swapping of data acquisition to spare detector system.

New RSSI will allow parallel monitoring of State of Health parameters, continuous Quality Checks of performance and capability for Parallel Spectrum Acquisition for the two operational detector systems.

AUP05 - Mawson (Certification Team)

AUP07 - Mawson (double system)