SnT 2025 CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
8 SEPTEMBER ONLINE DAY
9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE

Ultra Sensitive Measurements of Airbourne Nuclear Debris

LIGHTNING TALK

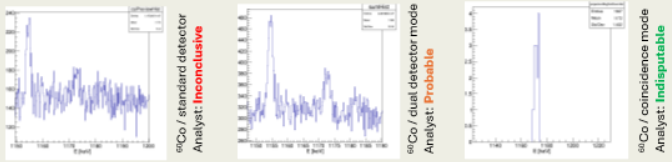
Richard Britton, Ashley Davies, Nikolaus Hermanspahn
CTBTO

P3.2-662

- How to improve reliability and uptime of radionuclide particulate sensors?
- How to make best use of existing equipment at stations?
- How to improve data for NDCs?
- How to modernise acquisition electronics and methods for Radionuclide systems?
- How to detect 'undetectable' UGTs on the IMS?

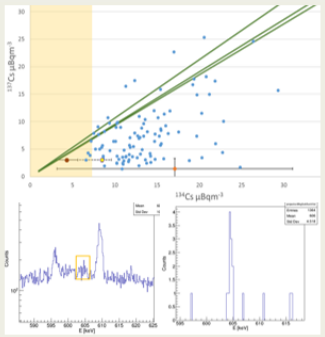
Eliminating false positives

- false positives create significant additional work for both IDC and NDC analysts
- dual systems provide a big step forward – coincidence systems a giant leap

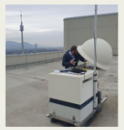


Improved results, better verification

- post Fukushima, IMS detections were often seen with a potential excess of ^{134}Cs
- bias mostly seen at low ^{134}Cs concentrations, typically due to poor peak fitting and low statistics
- with dual detector systems, measured values fall much closer to the theoretical decay corrected ^{134}Cs/^{137}Cs ratio
- [1] Based on the ^{137}Cs/^{134}Cs expected from fuel compositions in Fukushima-Daiichi nuclear power plant. JAEA-Data/Code 2012-018, Japan Atomic Nishihara, K., Iwamoto, H. and Suyama, K. (2012)

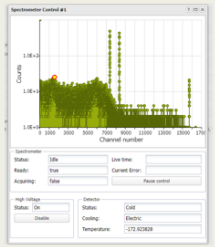


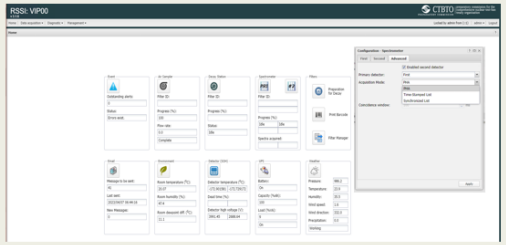
CURRENT IMPLEMENTATION AT VIP00



Clockwise from the left:
- Dual system at VIP00
- MCAs used and tested (LYNX 1&2)
- Snow White sampler on the roof of the VIC
- RSSI2 station software, with easy switching between single, dual and synchronised operations
- RSSI2 spectra diagnostics for real-time updates

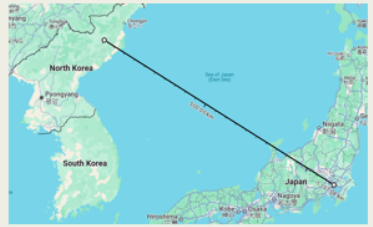
Modified station configuration with dual detector setup (two electrically cooled HPGe, with LYNX2 MCAs:
- Improved reliability (one detector failure does not compromise treaty measurement)
- Simplified setup using COTS components
- Additional Measurement capability (Pulse Height, List-mode, Synchronized List mode)
- Improved Data Availability
- Fully integrated in the latest version of RSSI
- Data compatible with F&P Rev8
- Improved analysis potential for NDC's
- Best use of spare detector, which should be kept cold and operational to prolong its useful life





Spiked sample to mimic a typical measurement that could occur from a UGT

- prompt gas release of 0.025% ^{140}Xe from a 1 kT device
- dilution factor of 10^{17}, to mimic typical transport across ~1000 km
- ^{140}Xe promptly decays into ^{140}Ba/La, providing a clear signature and nuclear clock with which to calculate fission zero time
- this scenario would go undetected on the current IMS
- using a dual detector system, you could measure it and get a zerotime
- using a dual system in coincidence, you could measure a signal 10x smaller (less release, or smaller UGT)



Mode	Energy	Signal (MDA), mBq	Zero time	Conclusion
Current IMS	^{140}Ba (537keV)	MDA (190-610)	Not Determined	No Detection
IMS (RN67)	^{140}Ba (537keV)	216 (142)	Not Determined	Detection, no zero time
Dual System (Sum)	^{140}Ba (537keV) ^{140}La (487keV)	153 (99) 66 (46)	18/3/2020 17:01	Detection and zero time
Dual System (coincidence)	^{140}Ba (305keV gate 162keV) ^{140}La (487keV gate 328keV)	156 (84) 67 (7)	18/3/2020 17:33	Detection and zero time

CTBTO PREPARATORY COMMISSION