



Monitoring of Ionizing Radiations facilities – Experience and challenge

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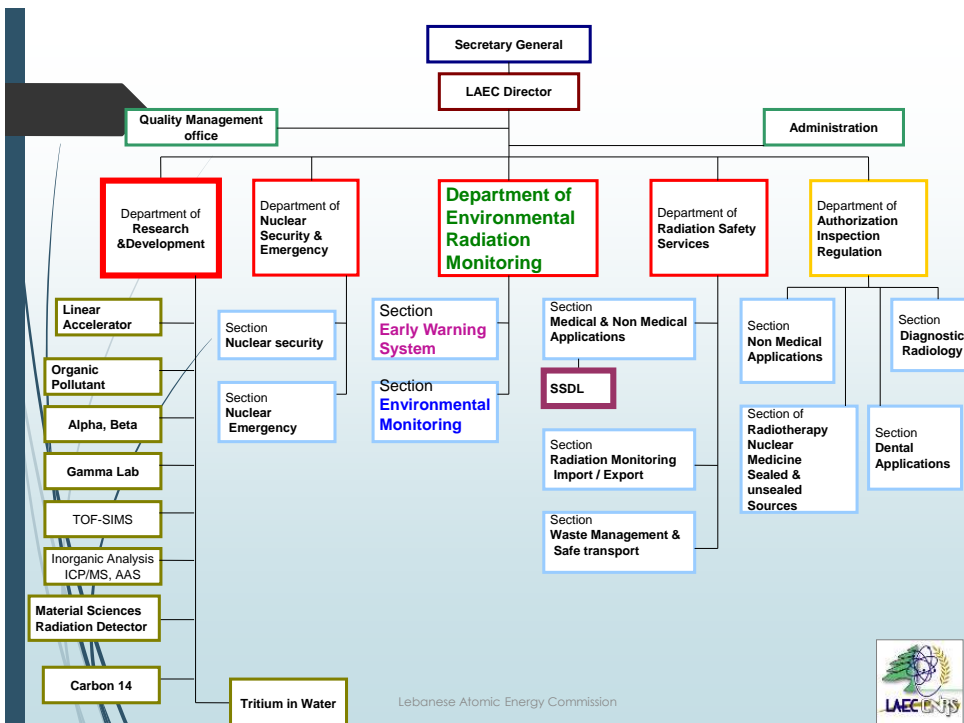
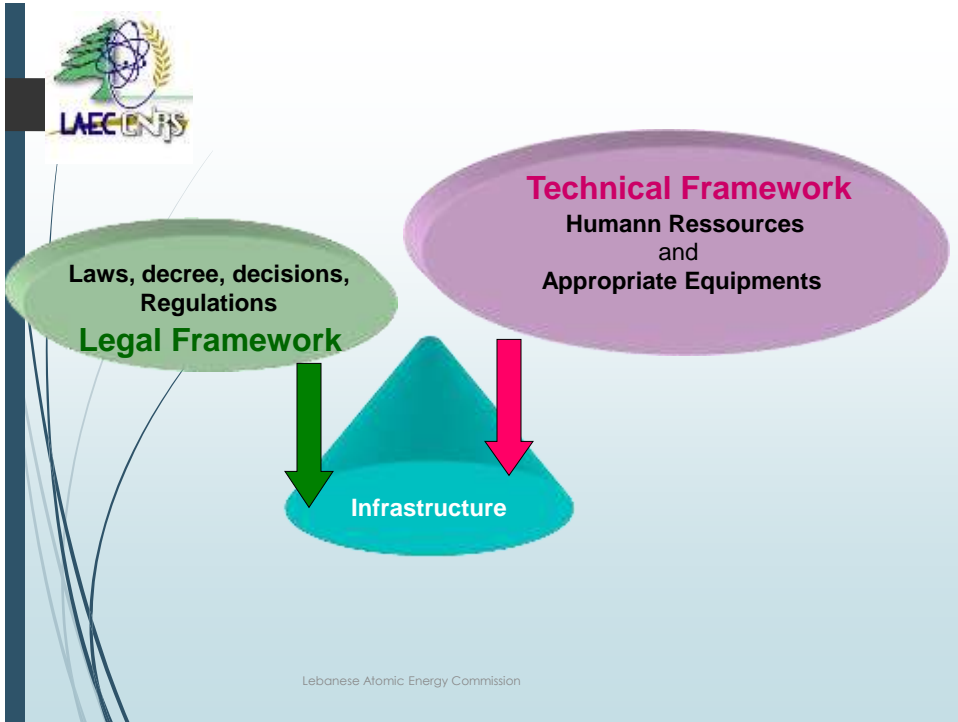


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The LAEC was established in 1996 with the full support and assistance of the IAEA, having the mandate :

- ▀ Encourage and develop the peaceful use of Atomic Energy in the country and spread the Culture of Safety and Security of ionizing Radiation Sources
- ▀ Make applied research using nuclear techniques and technologies
- ▀ Establish the national infrastructure for radiation protection and prepare the necessary legislations for protecting the public, workers and environment against ionizing radiation (via the establishment of a comprehensive regulatory system)

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Early Warning System

- ▶ Objective: monitoring dose rate in air ion continuous basis
- ▶ 20 monitoring sites distributed all over the Lebanese territory
- ▶ One central site at LAEC – Beirut; data analysis and archiving

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LAEC Activities (Radioprotection)- I

Authorization – Inspection – Regulation

- ▶ Issuing of national regulation relevant to the use of ionizing radiations in different practices
- ▶ Scientific and Technical evaluation for request of using ionizing radiations (import, export, uses,...)
- ▶ Inspection & control for the implementation of Radiation Protection guidelines in practices (BSS – IAEA)
- ▶ Establishment of National Register for the radioactive sources movement

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LAEC Activities (Radioprotection)- II

Radiation Safety Control

- ▶ Regular control of radiation exposure for workers in controlled area (TLD) ~3200 workers, >200 institutes
- ▶ Quality Control for equipments emitting of ionizing radiations used in medical, industrial and scientific field
- ▶ Workplace monitoring

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LAEC Activities (Radioprotection) - III

Protection against Ionizing Radiation



- ▶ Control of radioactivity level in exported food products and some imported food products
- ▶ Control of radioactivity (borders - ports) of imported construction metals and exported Scrap
- ▶ Assure the safety and security of transport of radioactive sources
- ▶ Help users in planning for radioactive waste management





LAEC Activities (Radioprotection) - IV

Control of radioactivity level in the Environment

- Regular analysis of food products water, soil, air, grass...
- Establishment of the Radioactivity Map Level in Lebanon (Soil – Background)
- Establishment of the Early Warning System for early detection of any radioactive contamination (accident, malpractice)

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LAEC Activities (Radioprotection) - V

Nuclear Security and Emergency

- Combating the Illicit Trafficking of Radioactive Sources (control on check points – CUSTOMS/LAEC). RPM projects
- Physical Protection of Category I-II sources (on site if used – re-exportation of disused)
- Providing Technical Support in emergency cases (Nuclear) and accident (local contamination)





Technical and Scientific Framework

Radiation Protection

1. TLD (Thermo Luminescent Dosimetry) for monitoring of **Personal Radiation Exposure**
 - 250 medical & industrial institutes (hospital private clinics, industries, research centers..)
 - > 3500 employee
- Laboratory got accredited in February 2015



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Technical and Scientific Framework

Radiation Protection

2. SSDL (Secondary Standard Dosimetry Lab). This laboratory is assigned under the **Lebanese Metrology Committee**

Activity: Calibration of Radiation Detectors used to control radiation leakage



Research and Development department

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Gamma Spectroscopy Detection

► Research field

- Detection of the activity of Gamma radiations in water, plants, soils and food products

► Instrument

- High Purity Germanium HPGe Detector for radionuclides measurement (30%, 40% and 60% efficiency)
- Sodium Iodide NaI Detector for screening of total gamma radiations





Alpha & Beta Spectroscopy Laboratory

- Research field
 - Detection of activity of radionuclide emitting Alpha and Beta radiations in food products, water, and soil
 - U, Pl, Am
- **Instruments:**
 - Alpha Spectroscopy
 - Liquid Scintillation



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Ionic Accelerator Laboratory

- Research Field
 - **Archeology:** Authenticity and provenance (ceramic, glass ware, coins, paints).
 - **Environment** (aerosols, soils, sediments, food).
 - **Materials Sciences** (semi-conductors, supra-conductors, ...)
 - **Medicine and Biology** (tissues, organs, hair, nail, blood).
- ☐ Instruments: Electrostatic Accelerator (PIXE, PIGE, RBS, GRDA, NRA techniques)



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Inorganic Chemistry Laboratories

- ▶ **Activity:** Trace and Major total elements measurement in environmental and food matrices and Isotope Ration
- ▶ **Instruments:** Ion couple Plasma / Mass Spectrometry- CRI - ICP/MS, Atomic Absorption Spectroscopy



Carbon 14 and Tritium in Water

- ▶ Research Field:
 - ▶ Hydrology and water treatment, pollution detection
 - ▶ Dating based on combustion of C14 (wood, paper, ...)





Time Of Flight- Secondary Ion Mass Spectrometry Laboratory

- ▶ Research field:
 - ▶ Elemental and molecular composition) of the uppermost atomic or molecular layer of a solid (or frozen liquid) which may be a metal, plastic or organic.
- ▶ Instruments:
 - ▶ TOF-SIMS instrument with two sources:
 - Bi source for spectrometry and imaging
 - Ar source for organic profiling in 3D.
 - ▶ With different operational modes,
 - surface spectroscopy,
 - surface imaging,
 - depth profiling and
 - 3D analysis



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Organic Pollutants and Pesticides Analysis Laboratory

- ▶ Research field:
 - ▶ Analysis of various organic pollutants (pesticides, PAH, PCB's, veterinary drugs,...) in environmental and food matrices
 - ▶ Development of new chromatographic separation methods, semi- volatile, Volatiles and organic pollutants
- ▶ Instruments:
 - GC/MS,
 - GC-ECD,
 - GC-NPD,
 - GC-FID,
 - HPLC,
 - LC/MS





Participation within MAPEP scheme

- ▶ Added values for our technical performance
- ▶ Opportunity to detect analytical shortage
- ▶ Variety of samples and analytes (radionuclide and trace elements)

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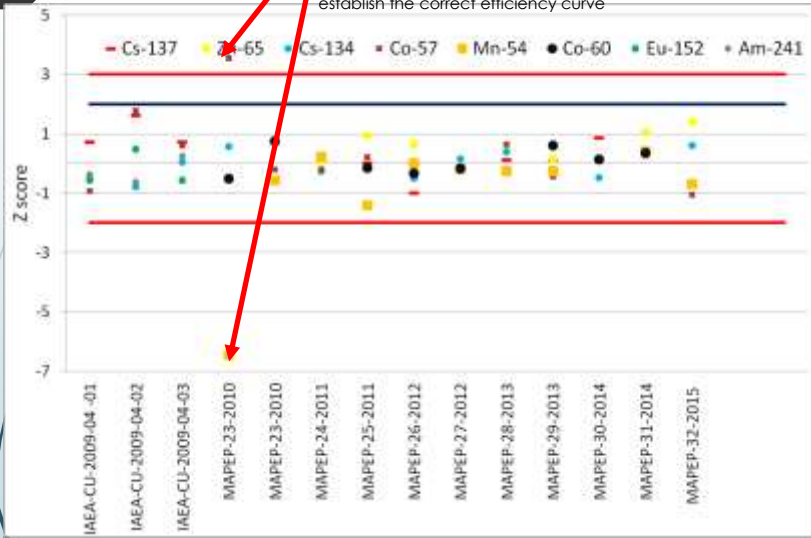


Gamma Spectroscopy lab performance through Z-score evaluation

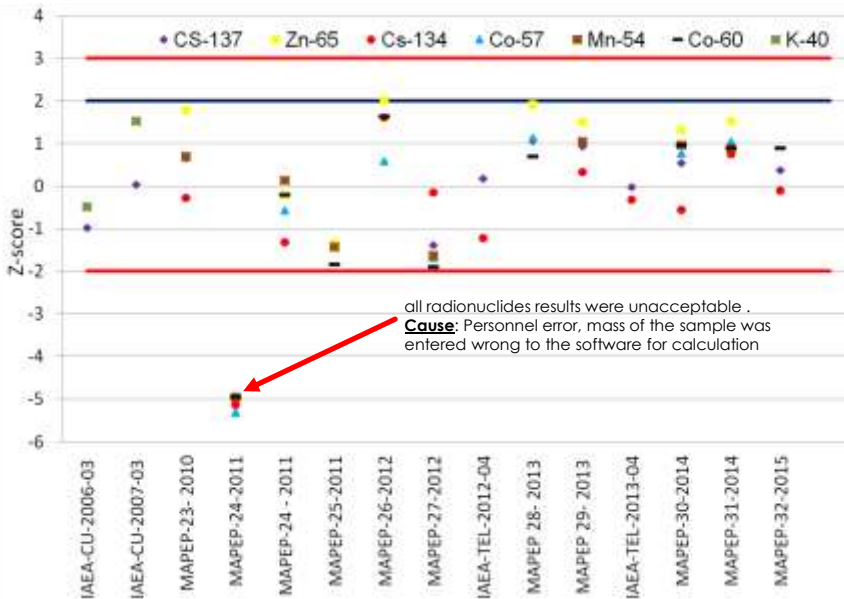
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Cause: the efficiency curve for air filters was not established yet due to non availability of reference air filter of same geometry in the lab , Manual calculation was done by comparison with left over PT filter from IAEA of **approximately** similar geometry .

Corrective actions after getting results this filter was used to establish the correct efficiency curve

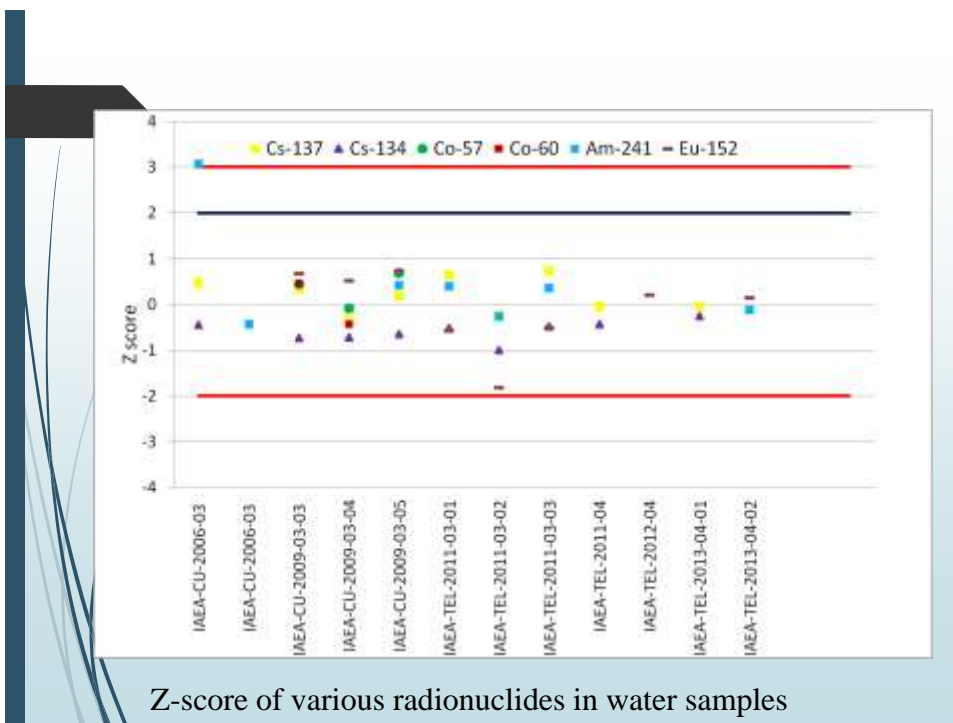
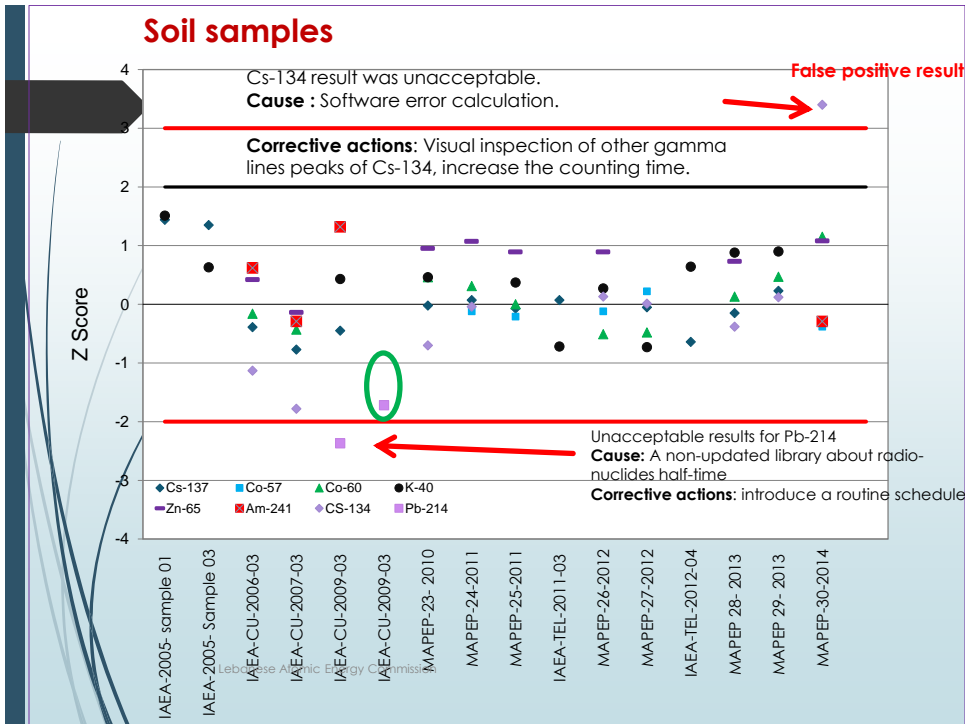


Z-score of various radionuclides in air filter



all radionuclides results were unacceptable .
Cause: Personnel error, mass of the sample was entered wrong to the software for calculation

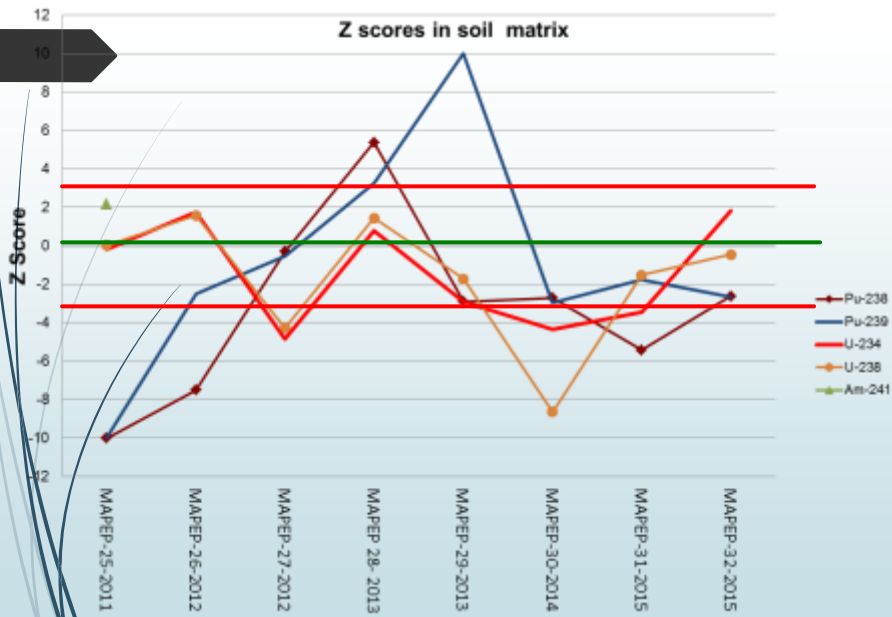
Z-score of various radionuclides in organic dry samples (vegetation and flour)

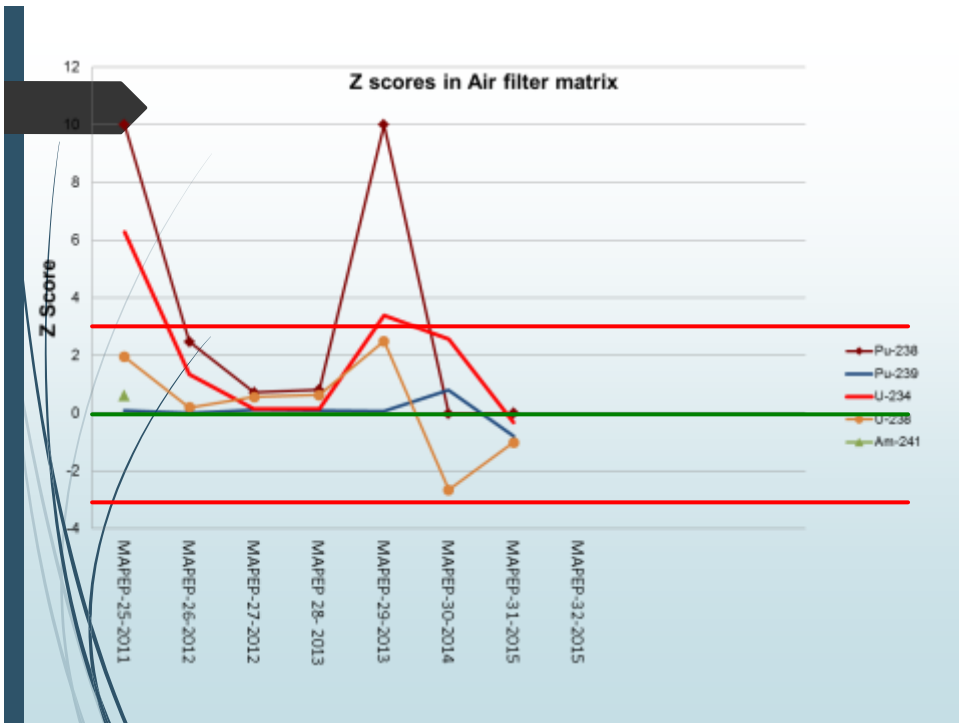
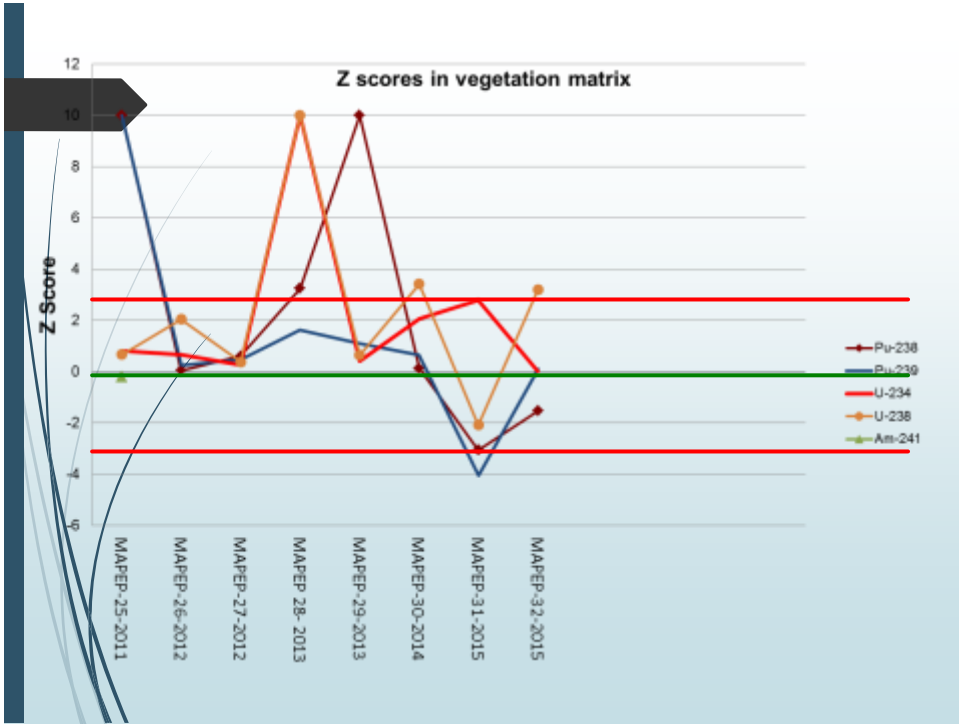


Z-score of various radionuclides in water samples

Alpha scintillation laboratory performance through Z-score evaluation

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Alpha scintillation


- ▶ Problem with sample digestion due to silica presence in soil sample (presence of interferences)
- ▶ Not enough air filter samples
- ▶ Grass sample is not very well sealed.
- ▶ Mass of Soil sample is few as we need 500 ml volume to cover validated geometry in gamma spectroscopy.

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Challenges with Radiation Monitoring Facilities

- ▶ Availability of local suppliers for standards and equipments
 - Long bureaucratic process for importing approval
- ▶ Development of technical procedures for optimizing measurement conditions
- ▶ Proof of credibility of measurement through implementing "Quality Management System"
- ▶ Verification of well performance of equipments and software

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**Thank you for your
attention**

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