Practical gamma measurements at IFE - natural activity.

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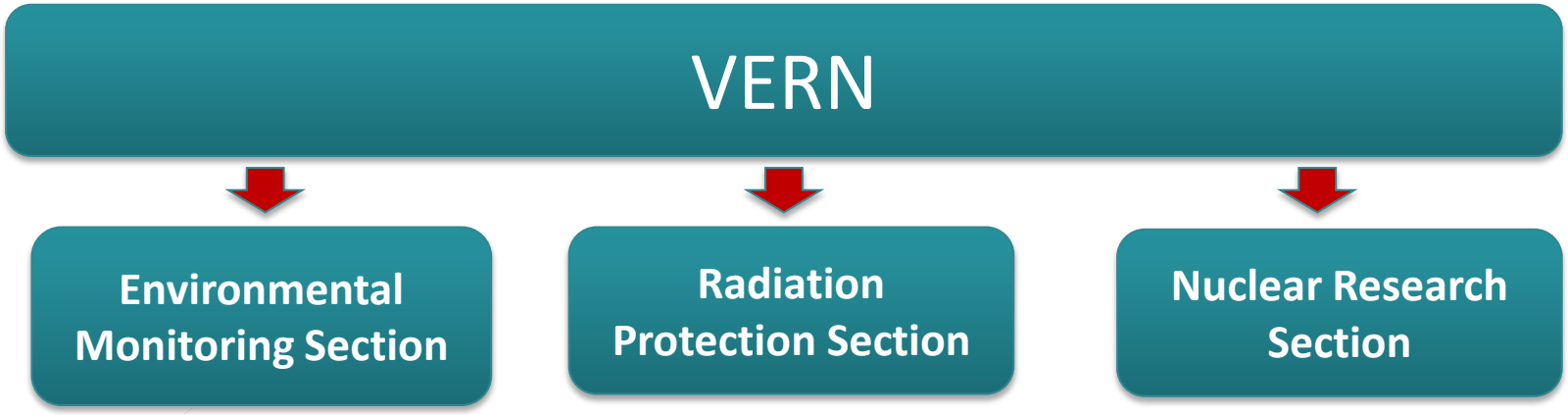
Institute for Energy Technology (IFE)

- IFE operates the two existing nuclear reactors in Norway.

  Both are dedicated to research.

Health and Safety Department (VERN)

- Department Head: Elisabeth Strålberg
- Employees: 22



Environmental Monitoring Section

Types of samples

Industrial

- Oil and gas industry
- Mineral industry

Environmental

- Water
- Sediment
- Stones
- Grass
- Milk
- Grain
- Fish
- Aquatic plants
- Blueberries

from IFE's activities

- Discharges of radioactive nuclides from IFE

Biological

- Urine

Environmental Monitoring Section

Instrumentation

α-radiation:
spectrometry with PIPS-detectors

β-radiation:
liquid scintillation spectroscopy with RISØ low level detectors

γ-radiation:
HPGe-detectors

Environmental Monitoring Section

5 Low Level Radioactivity Laboratories

Analysed radionuclides:

- ^{3}H,
- ^{60}Co,
- ^{90}Sr,
- ^{137}Cs,
- ^{210}Pb,
- ^{210}Po,
- ^{226}Ra,
- ^{228}Ra,
- $^{234,235,238}U$,
- $^{228,232}Th$,
- $^{238,239,240}Pu$
- ^{241}Am.

Environmental Monitoring Section

Full chain of gamma analysis

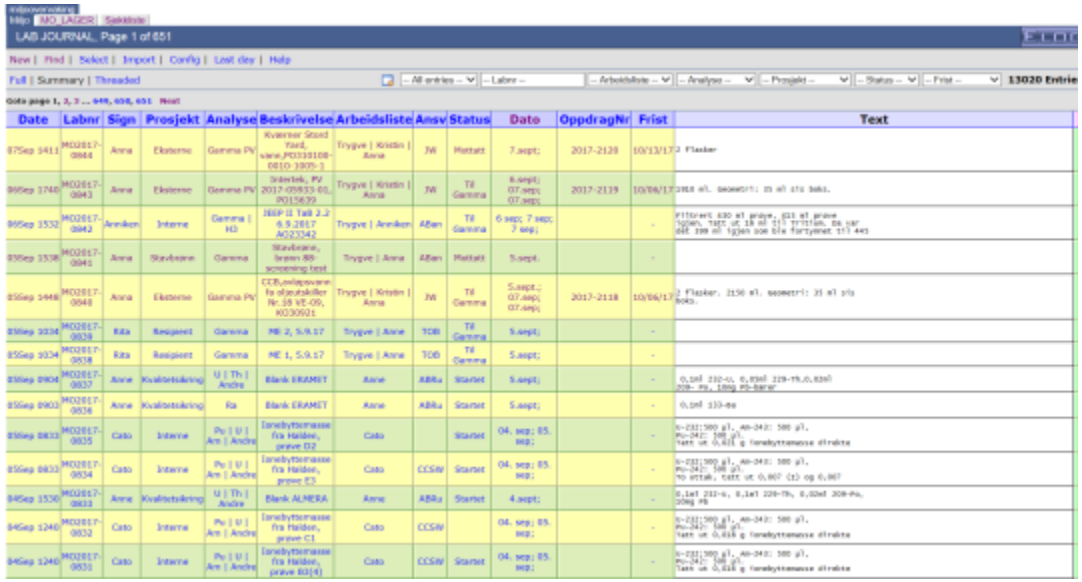
Sample registration → Sample preparation → Gamma Analysis → Data analysis

Sample registration- The Electronic Log Book (ELOG)

ELOG is an organizing/logistic utility run from a local server.

https://midas.psi.ch/elog/

- Order of the analysis
- Handling of deadlines
- Sampling
- Sample processing
- Measurements
- Reporting
- Sending of invoices



Sample preparation

- Sample homogenization (drying/evaporating, crushing, ashing)
- Radiochemical preparation
- Vacuum packing (e.g. stone samples)

Facilities & equipment

- One room for γ counting

(for low activity concentrations of natural radionuclides)

- External 180l nitrogen tank.
- Air ventilation (air inn from top and air out from bottom)
- Oxygen sensor with alarm and steering the air flow.
- Monitoring of temperature, humidity.

Equipment: High-resolution gamma detectors

6 HPGe-detectors (Ortec & Canberra)

(relative efficiency 20-50 %)

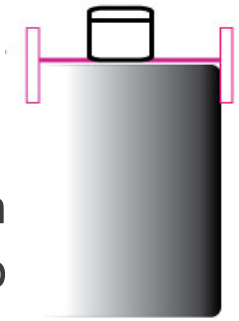
3 detectors: n-type

2 detectors: low energy p-type

1 detector: normal p-type

Detectors from 1983 to 2012.

Detectors are shielded with 10 cm lead to limit background radiation.



Samples are measured on top in a teflon holder at the detector end-cap

Gamma Analysis - Measurement geometries

- Petri dish full
- Filter in bottom petri dish
- Box P-35 filling height 5mm
- Boc P-35 filling height 25mm
- Box P-105 filling height 10mm
- Box P-105 filling height 25mm
- Scintilation vial filling height 5mm
- Scintilation vial filling 20ml
- 500ml plastic bottle filling 200ml
- 500ml plastic bottle filling 445ml

**Plastic boxes P-35, P-105 from VS-Automaatio OY, Pajatie 7, 23500 Uusikaupunki, Finland.*

Gamma Analysis – with self-absorption

- ^{210}Pb and ^{226}Ra activities are corrected for self-absorption in the sample.

- Point source: $^{226}Ra/^{210}Pb$

Gamma Analysis

Detection limit

< 1 Bq/liter (or 1 Bq/kg) for biological, soil or sediment samples.

More sample material and longer counting time yields lower detection limits.

Detection limits are calculated by the software according to ISO 11929.

Quality control

- Energy and efficiency calibrations
- Monthly measurement of certified point sources
- Controls for background radiation
- Intercomparison exercises arranged by the IAEA, NPL, NIST and NKS.

Data analysis

Gamma spectrometry analysis software:
GammaVision v.8 from Ortec.

Nuclide Library from
http://www.nucleide.org/LaraWeb/

Number of gamma-ray analyses in VERN in 2016

920 samples

External: 40%
Internal: 60 %

gamma m/abs: 30%
gamma: 70 %

Thank you for your attention