



Practical gamma measurements at IFE - natural activity.

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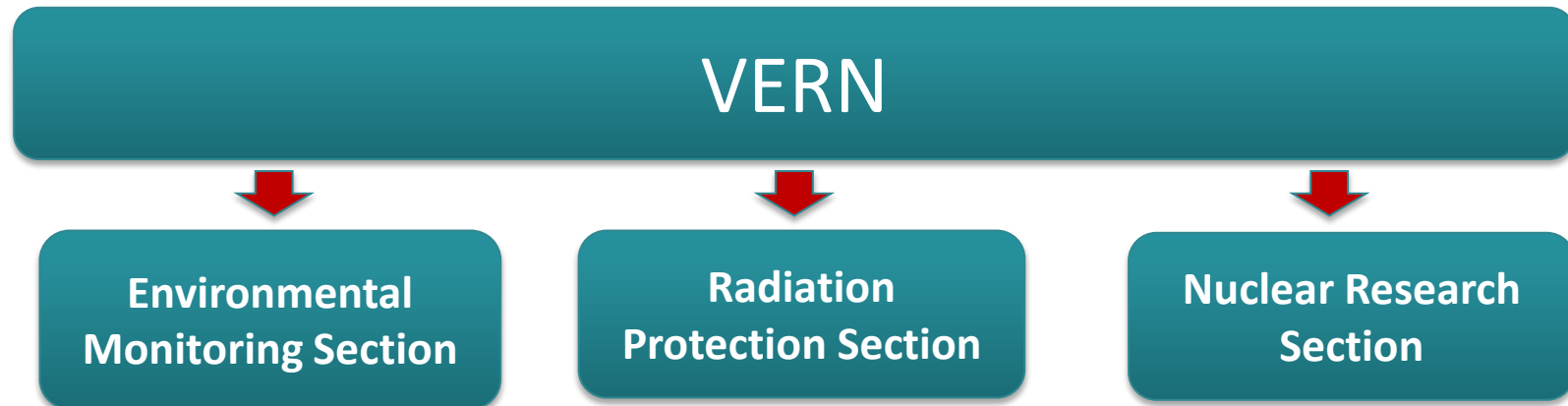
Institute for Energy Technology (IFE)

- 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

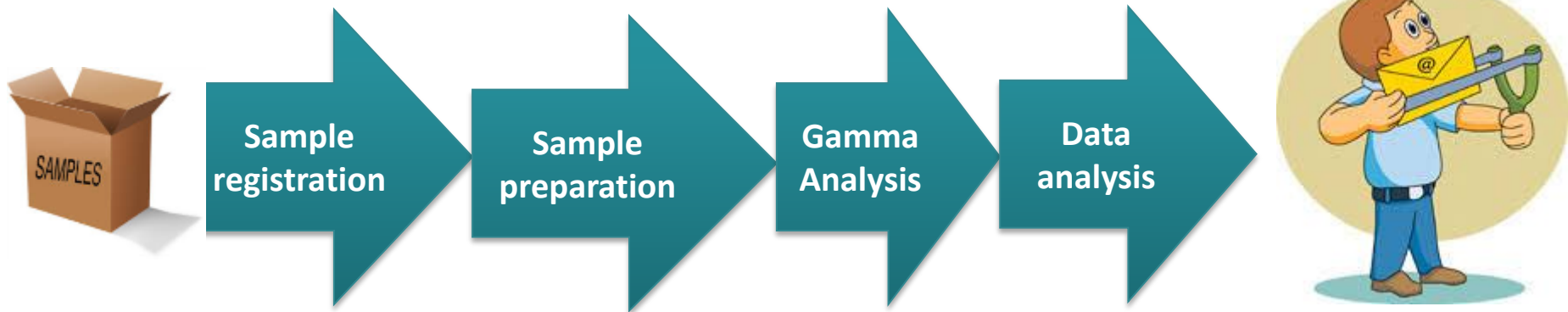
Analysed radionuclides:

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



Environmental Monitoring Section

Full chain of gamma 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

LAB JOURNAL, Page 1 of 851

Full | Summary | Threaded

data page 1, 2, 3 ... 948, 950, 952 Next

Date	Labnr	Sigs	Prosjekt	Analyse	Beskrivelse	Arbeidsliste	Ansv	Status	Dato	OppdragNr	Frist	Text
87Sep 2411	MO2817-0844	Akne	Ekstern	Gamma PV	Kvalitet 2002 FASE	Trygve Kristin Akne	JW	Modert	7.sept.	2017-2128	10/13/17	Flasker
89Sep 1740	MO2817-0842	Akne	Ekstern	Gamma PV	2017-09-13-05_2017-09-13	Trygve Kristin Akne	JW	TE Gamma	8.sept. 07.sept. 07.sept.	2017-2128	10/06/17	2128 wL, bokser: 25 wL sto 260L
89Sep 1532	MO2817-0842	Akne	Intern	Gamma HD	SDP-12 Tab 2.2 5.9.2017 A022142	Trygve Akne	ADan	TE Gamma	6.sept. 7.sept. 3.sept.			Fliserte 230 wL pram., 201 wL pram. 120wL, 107 wL, 10 wL 211 171110, 08 sep 081 200 wL 1700000 016 Fortylket 111 440
89Sep 1338	MO2817-0841	Akne	Skadestorn	Gamma	Waldstein, Screen 80, screening test	Trygve Akne	ADan	Modert	5.sept.			
89Sep 2448	MO2817-0848	Akne	Ekstern	Gamma PV	CCF-maltesvoren for skadestorn Nr. 18 VE-05, W030921	Trygve Kristin Akne	JW	TE Gamma	5.sept. 07.sept. 07.sept.	2017-2128	10/06/17	2 Flasker, 2150 wL, bokser: 25 wL sto 260L
89Sep 2234	MO2817-0838	Rita	Resipient	Gamma	ME 2, 5.9.17	Trygve Akne	TDB	TE Gamma	5.sept.			
89Sep 2234	MO2817-0838	Rita	Resipient	Gamma	ME 1, 5.9.17	Trygve Akne	TDB	TE Gamma	5.sept.			
89Sep 2104	MO2817-0837	Akne	Kvalitetskontroll	U Th Akne	Blank ERAMET	Akne	ABRu	Startet	5.sept.			0,26L 212-w, 0,26L 219-Th, 0,26L 208-Th, 0,26L 209-Th
89Sep 2102	MO2817-0836	Akne	Kvalitetskontroll	Ra	Blank ERAMET	Akne	ABRu	Startet	5.sept.			0,26L 212-w
89Sep 2033	MO2817-0835	Cato	Intern	Ph U Am Andre	Inventurmasse fra Halden, gruppe 02	Cato	CCSN	Startet	04.sept. 05. sep.			0,22L 190 wL, 40-04: 500 wL, 0,24L 500 wL, 70 wL, 545L ut, 0,90L (12) og 0,90L
89Sep 2033	MO2817-0834	Cato	Intern	Ph U Am Andre	Inventurmasse fra Halden, gruppe 03	Cato	CCSN	Startet	04.sept. 05. sep.			0,22L 190 wL, 40-04: 500 wL, 0,24L 500 wL, 70 wL, 545L ut, 0,90L (12) og 0,90L
89Sep 1730	MO2817-0833	Akne	Kvalitetskontroll	U Th Akne	Blank A-MESA	Akne	ABRu	Startet	4.sept.			0,14L 212-w, 0,14L 219-Th, 0,26L 208-Th, 0,26L 209-Th
89Sep 1240	MO2817-0832	Cato	Intern	Ph U Am Andre	Inventurmasse fra Halden, gruppe C1	Cato	CCSN	Startet	04. sep. 05. sep.			0,22L 190 wL, 40-04: 500 wL, 0,24L 500 wL, 70 wL, 545L ut, 0,90L (12) og 0,90L
89Sep 1240	MO2817-0831	Cato	Intern	Ph U Am Andre	Inventurmasse fra Halden, gruppe B1(4)	Cato	CCSN	Startet	04. sep. 05. sep.			0,22L 190 wL, 40-04: 500 wL, 0,24L 500 wL, 70 wL, 545L ut, 0,90L (12) og 0,90L

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

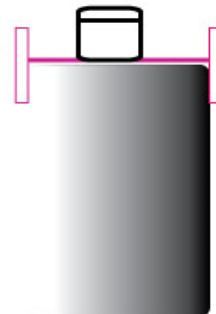
2 detectors: low energy p-type

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
- Scintillation vial filling height 5mm
- Scintillation 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: $^{226}\text{Ra}/^{210}\text{Pb}$



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