

Measurements of NORM in the Norwegian Oil and Gas Industry

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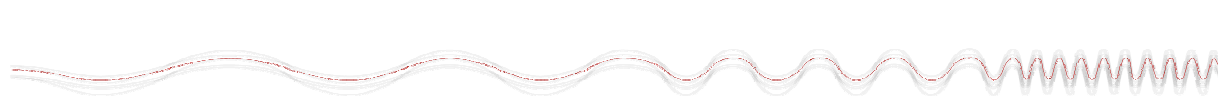
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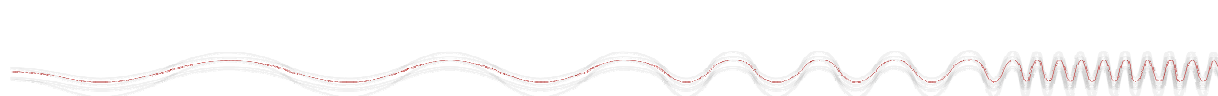
Background

- The 1st of January 2011 a new **Regulation relating to the application of the Pollution Control Act on radioactive pollution and radioactive waste** come into force in Norway.
- In 2010 a work evaluating the instruments used by the oil and gas industry was carried out
- NRPA decided in the beginning of 2011 to start a two years project to assess the procedures for measuring and the measuring equipment used in the industry



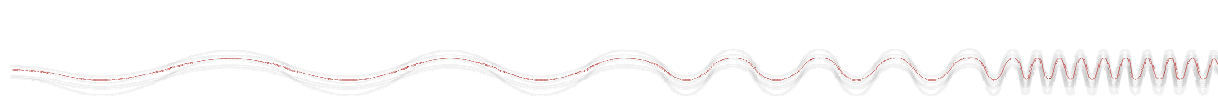
The content of phase one of the project

- Summary of the results of measurements carried out in 2010
- Do some experiments to look for improvements of the measurements
- Give a description of how the waste and equipment containing radioactivity is handled when it is landed on a base onshore



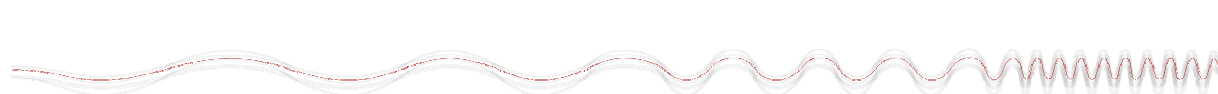
Methods of measurements

- Gamma spectrometry measurements
 - NaI- or LaBr- detectors
- Gross β -measurements
 - “Puck-method”



Experimental work with NaI and LaBr detectors

- Objectives:
 - Examine if spectra from small LSA-scale samples and relatively short measurement times can be used to estimate the activity concentration of Ra-226 and Ra-228 at activity concentration levels around 1 Bq/g
- Dector systems
 - 3"x3" NaI-detector connected to a portable multichannel analyser
 - 1,5"x1,5" LaBr-detector connected to a portable multichannel analyser



Test samples

- Test samples
 - Three LSA-scale standards prepared by Institute of Energy (IFE) with activity up to 26.5 Bq/g for Ra-226



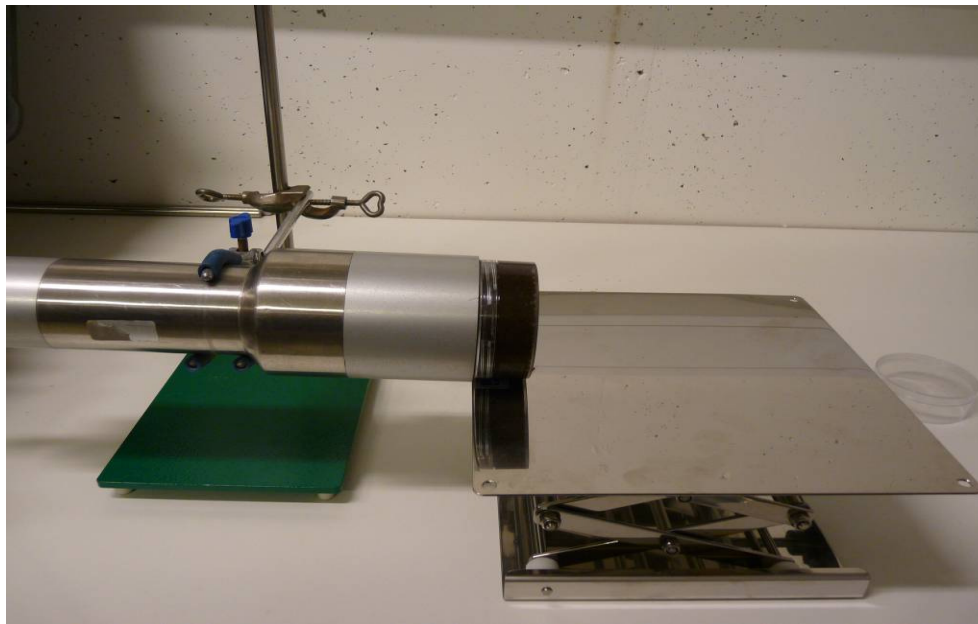
- Two samples prepared from IAEA reference materials,
 - * IAEA-434 Phosphogypsum
 - * Diluted IAEA RG-Th-1 thorium powder



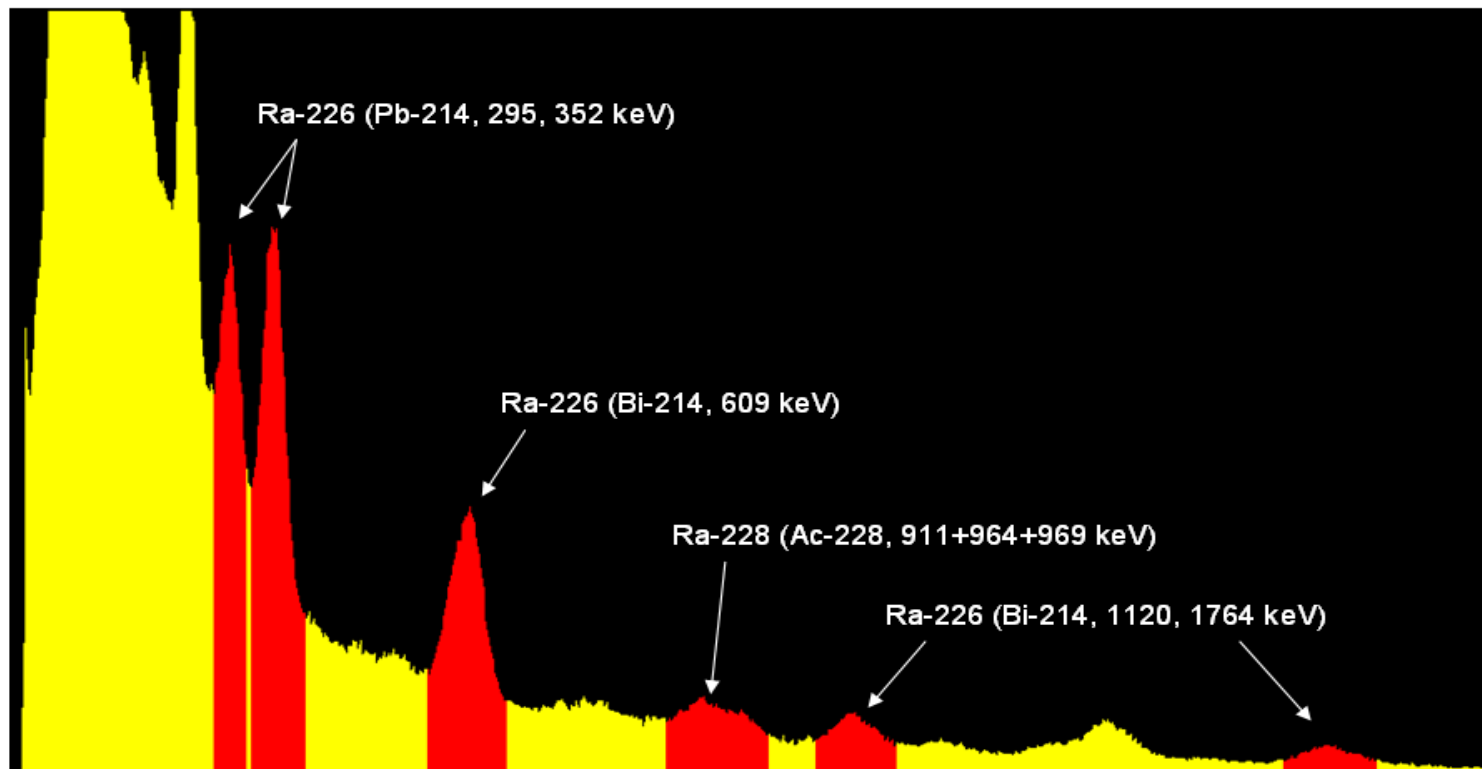
Experimental set up

- Methods

LSA-waste samples with different activity concentrations were analysed with an unshielded NaI- and a LaBr- detector for 5 and 15 minutes respectively. One samples was also analysed with lead shielding for comparison.



Spectrum



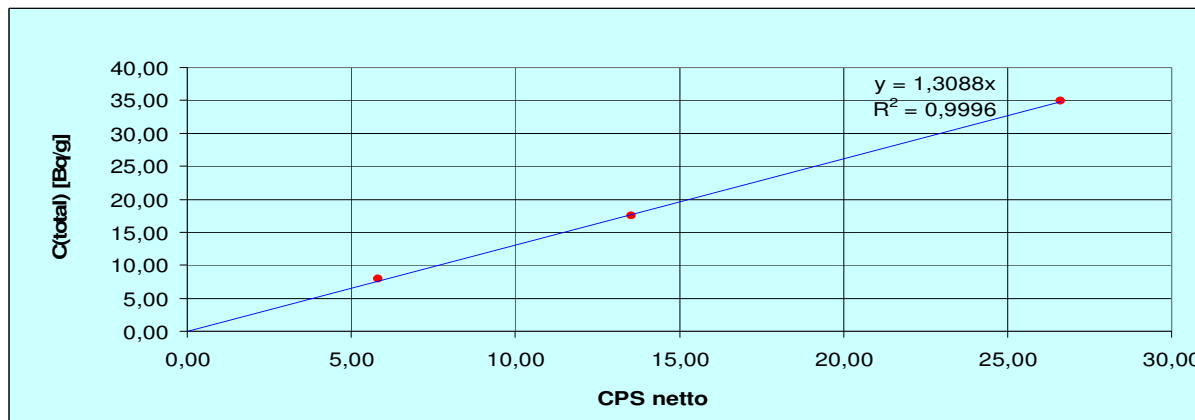
Some conclusions from the experiment

- Conclusions
 - Using gamma spectrometry as a field method to analyse Ra-226 and Ra-228 in LSA-scale around the clearance limit of 1 Bq/g for small samples are difficult with respect to detection limits.
 - In order to reach a lower detection limit with the gamma spectrometric method one could use larger samples, increased shielding and longer measurement times.
 - The NaI-detectors have a higher efficiency than the LaBr-detectors which gives a lower detection limit.
 - The method needs to be tested further before a final conclusion is drawn.



Gross β -measurements – the “puck-method”(I)

- A method to estimate the activity concentration in LSA scale that is widely used on the Norwegian Continental Shelf
- A β -sensitive instrument or probe connected to a rate meter is calibrated with three or more well characterised puck standards in the activity interval 8 – 35 Bq/g.



Gross β -measurements – the “puck-method” (II)

- A screening method suitable for the new regulation should be able to detect activity concentrations in LSA-scale samples below 1 Bq/g (for the sum of Ra-226 and Ra-228)
- The detection limit of this method, as it is used to day, is estimated to be about 1-2 Bq/g for Ra-226 and Ra-228 in LSA-scale
- The detection limit could be lowered by:
 - Improve the counting efficiency of the method
 - Lower the background signal by using shielding
 - Increase the measurement time
- The practise today for the “puck-method” is to use direct readings on the rate meter, or as recommended in IFE, to analyse the sample for 30-60 s.



Experimental work

- Measurement time was set to 180 s.
- Two different reference materials, one containing mainly Ra-226 and one containing mainly Ra-228, were used for this purpose:
 - 1) IAEA-434 Phosphogypsum, containing:
 - U-238: 0.12 ± 0.01 Bq/g, U-234: 0.12 ± 0.01 Bq/g, Th-230: 0.21 ± 0.01 Bq/g, **Ra-226: 0.78 ± 0.01 Bq/g**, Pb-210: 0.68 ± 0.01 Bq/g
 - 2) IAEA-RG-Th-1 thorium ore powder diluted with flour.
 - Sample 1: **Th-232** (all daughters in secular equilibrium): **0.74 Bq/g**
 - Sample 2: **Th-232** (all daughters in secular equilibrium): **1.18 Bq/g**

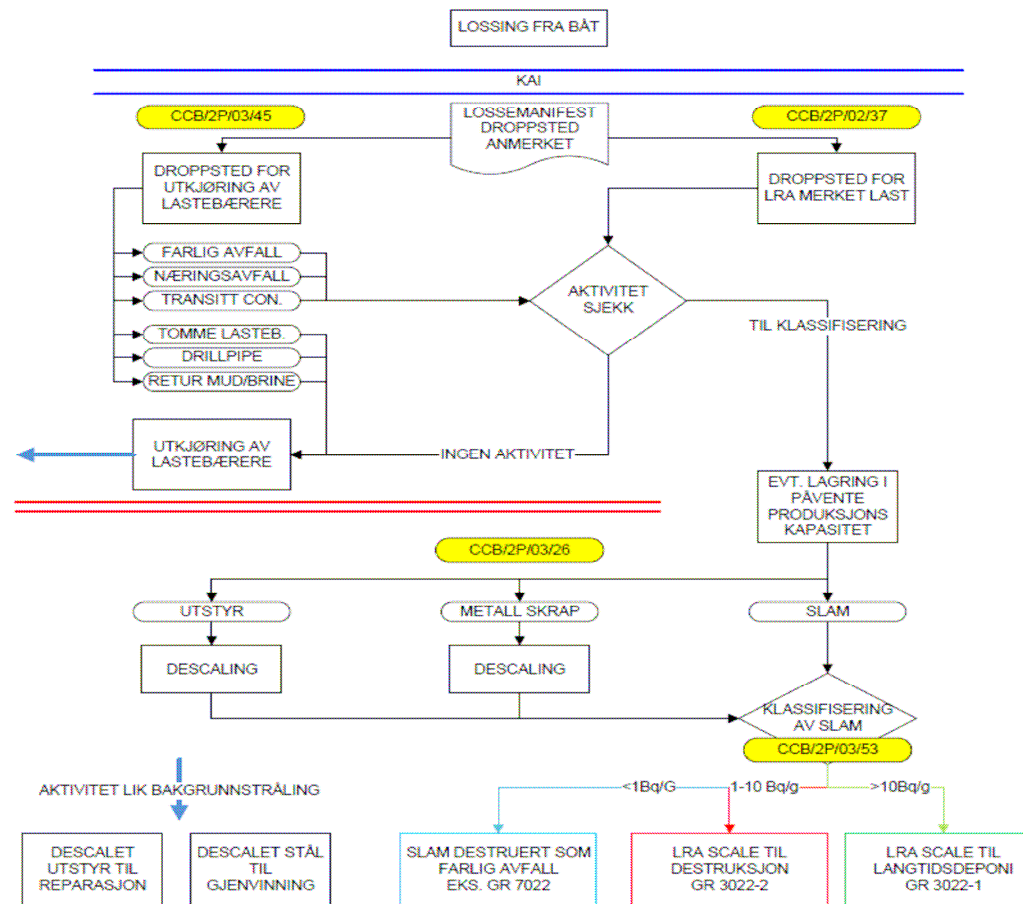


Results from the experiments

- **Average results of analyses of IAEA-434 Phosphogypsum: 0.81 Bq/g with 1SD: 0.07 (Ra-226: 0.78+/- 0.01 Bq/g)**
- **Average results of analyses of IAEA-RG-Th-1 thorium ore powder:**
 - **Sample 1: 0.89 Bq/g with 1 Sd 0.03 (Ra-228: 0.74 Bq/g)**
 - **Sample 2 . 1.21 Bq/g with 1 Sd 0.05 (Ra-228: 1.18 Bq/g)**
- **Gross β -measurements could be possible to use for screening/classification of scale with the new clearance limit of 1 Bq/g.**
- **Use of longer measurement times when the activity concentration is below a particular limit could give better results**
- **Needs more tests before a final conclusion is drawn**

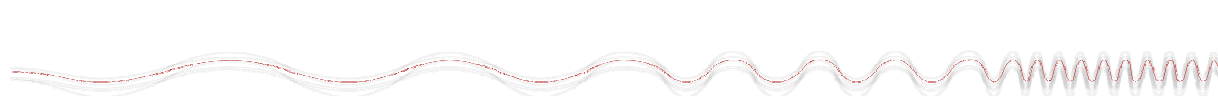


Handling of LSA on a landbase



Further work

- Next phase of the project will contain:
- Test the different instruments and measuring times on various kind of waste; scale, sand, sludge, contaminated equipment (tubes, valves etc)
- Measurements on contaminated substances like absorbents, gloves etc
- Measurement set up and measurement times to give representative results also for heterogeneities in the content of the drums



ALARA 2011

Thank you for your attention!

