Surface Activity Measurements In Situ at Ringhals NPP

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• Purpose of the measurements
• Equipment
• Efficiency calibration
• Example of results
Purpose of the measurements

• The measurements are done to follow the deposition of corrosion products inside pipes, vessels and heat exchangers.

• This is important, especially for radiological protection and chemistry to minimize doses to the workers. Increased deposition will lead to higher collective doses.

• Changes during the operating cycle of the reactor might change the radiological environment.
Measurement

- Acquisition time ~ 1-2 days including background measurement

**Nuclide library**

- Be- 7
- O- 19
- Mn- 54
- Cr- 51
- Co- 57
- Fe- 59
- Zn- 65
- As- 76
- Co- 58
- Nb- 94
- Ru- 103
- Co- 60
- Ru- 106
- Ag- 108m
- Zr- 95
- I- 131
- I- 132
- Nb- 95
- I- 133
- Cs- 134
- Au- 110m
- Cs- 136
- Cs- 137
- Sn- 113
- Ba- 140
- La- 140
- Sb- 122
- Ce- 141
- Ce- 144
- Sb- 124
- Pr- 144
- Eu- 152
- Sb- 125
- Hf- 181
- Ta- 182
- W- 187
- Np- 239
Equipment

HPGe-Detector, rel eff between 4-8%

Collimators (30, 22, 12mm and background)
**Efficiency Calibration**

\[ \text{eff}_{\text{abs}} = \text{eff}_{\text{int}} \times \text{eff}_{\text{geo}} \]

- \( \text{eff}_{\text{int}} \) – intrinsic efficiency for the detector
  - Performed in the laboratory with a surface source of Eu-152

- \( \text{eff}_{\text{geo}} \) – calculated correlation between the surface source calibration (\( \text{eff}_{\text{int}} \)) and the real geometry for the measured sample
Efficiency calibration

- Intrinsic detector efficiency
- Absolute efficiency
  (Pipe $\phi = 700\,\text{mm} ; t=67\,\text{mm}$)

![Graph showing efficiency vs. energy](chart.png)

Energy [keV] vs. Efficiency [m$^2$.cps/Bq]
[1] 30-321 RH REVISION Ag-110m ( ) Bq/m²
[1] 30-313 CROSS LEG LOOP 3 Ag-110m ( ) Bq/m²
[1] 30-334 CVCS FJB REVISION Ag-110m ( ) Bq/m²
SU - RINGHALS 3

Co58

[1] 30-334 CVCS FJB REVISION Co-58 ( ) Bq/m²
[1] 30-312 MWI ÅG 3 KALL SIDA Co-58 ( ) Bq/m²
[1] 30-312 MWI ÅG 3 VARM SIDA Co-58 ( ) Bq/m²
[1] 30-313 HOTO LEG LOOP 3 Co-58 ( ) Bq/m²


User: okus

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Thank you for your attention!