

Alpha Airborne Radioactivity at Forsmark NPP

Distribution of Alpha Active Nuclides in the Ventilation System

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April 2014

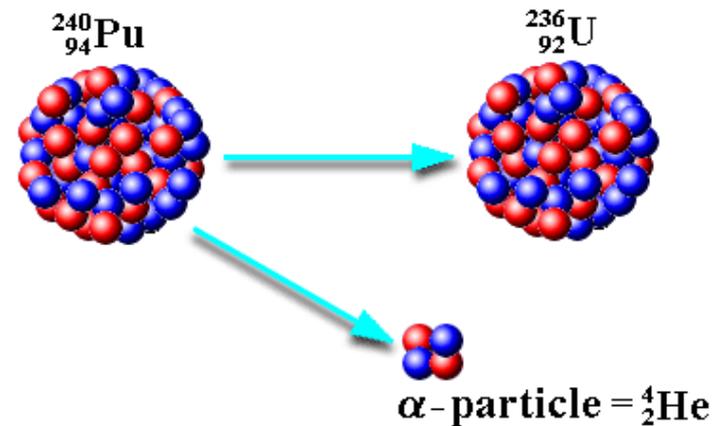
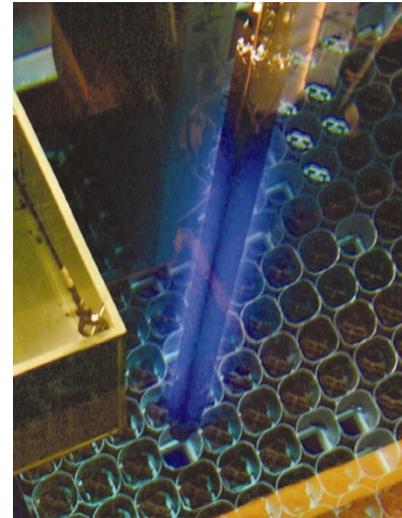
Presentation Outline

- Introduction
- Method
- Results
- Conclusions



Introduction

- Forsmark NPP
 - 3 BWR
 - ASEA Atom, 1980-1985
- Alpha emitting nuclides
 - Actinides (U, Pu, Am, Cm)
 - Produced in the fuel.
 - Degraded fuel failure.
 - Long-lived
 - Radon daughters
- Alpha particles
 - Short range → hard to detect
 - High RBE → do not eat/inhale

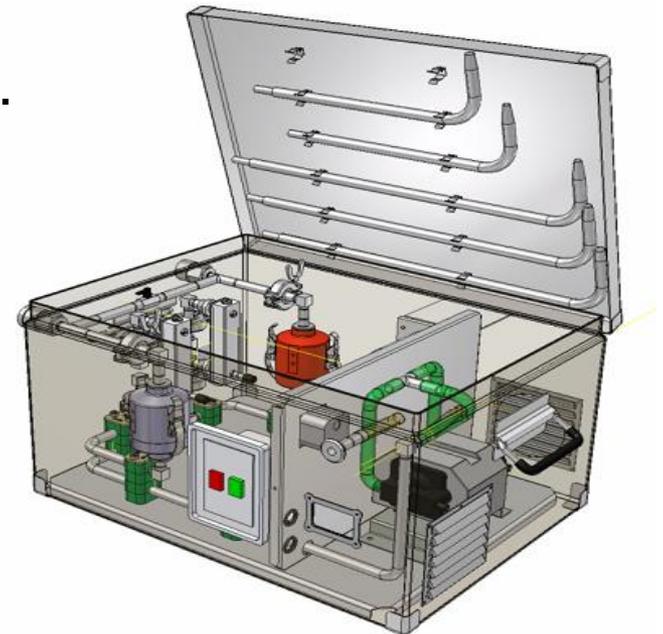
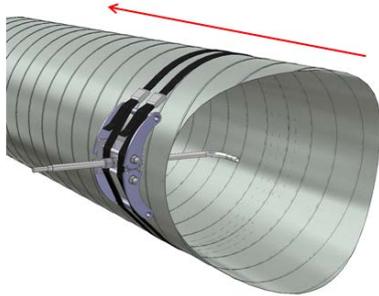


Method – aerosol sampling

Mobile sampling boxes connected to the ventilation system collect a representative airflow which is lead through a filter inside the box.

The boxes are routinely used to monitor aerosols (e.g. Co-60) inside the plants.

Air filters are changed regularly and analysed.



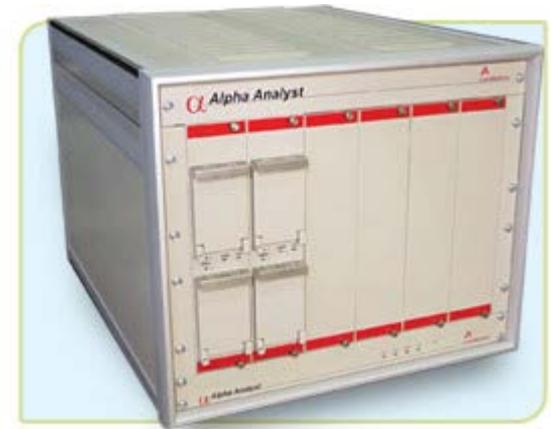
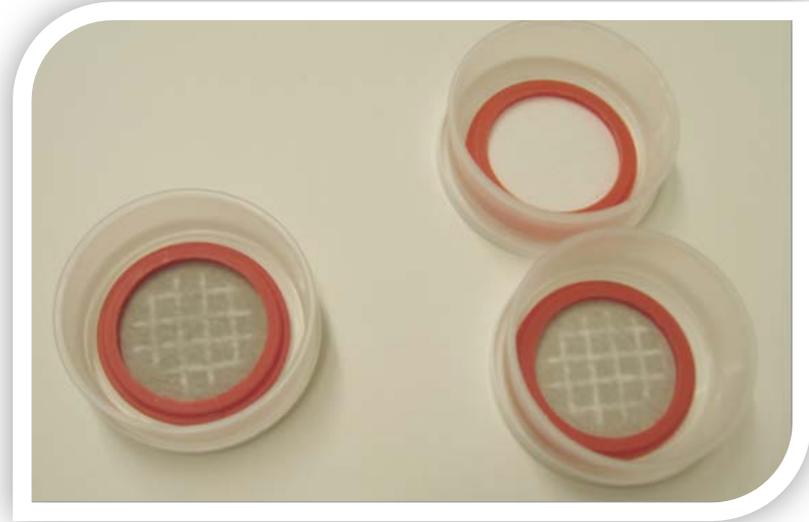
Ventilation systems at 3 units

- Reactor building
 - Monitored for a year and analysed quarterly.
- Turbine building
 - Two time periods; outage and in operation.
- Ventilation system for active gases before filtration
 - Two time periods; high and low/no gamma activity.

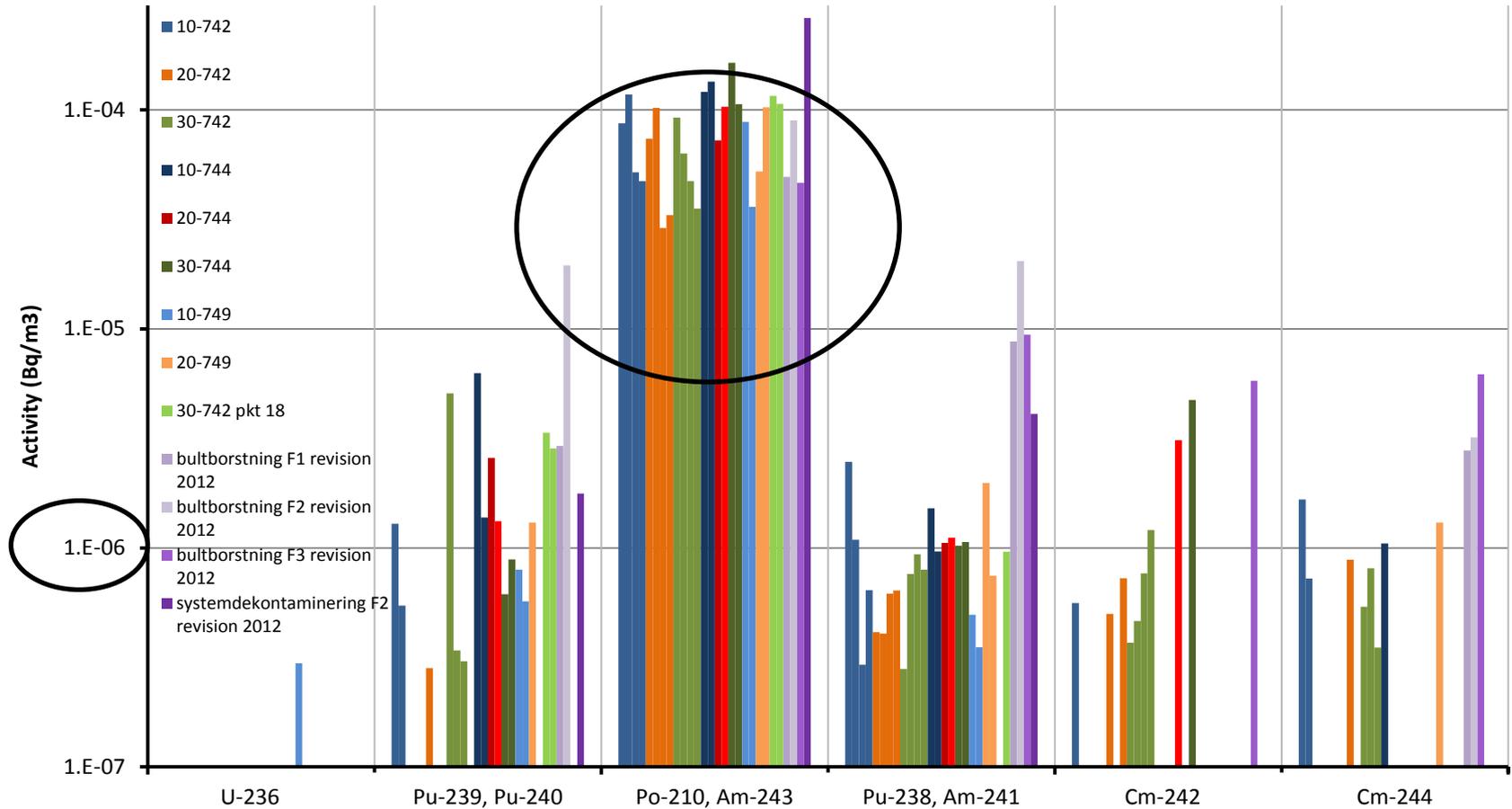
Mobile filters used for aerosol producing tasks performed during annual outages.

Method – nuclide specific alpha analysis

- Air filters were leached and electrodeposited on metal discs.
- Alpha Analyst (PIPS-detectors, vacuum) was used for nuclide specific determination.
- Long-time measurement gives a very low detection limit.
- No separation of elements.
 - Am-241/ Pu-238
 - Am-243/ Po-210



Results



More Results

- 96 % of the detected airborne alpha active nuclides in the ventilation system is due to radon gas.
- The results are in agreement with theoretical values.
- Turbine buildings have slightly elevated levels of alpha activity compared to the reactor buildings. Caused by reverse flushing of precoat filters into the condensate polishing plant.
- No correlation to high and low gamma activity (Co-60).
- Short-lived Cm-242 is detected more frequently at the unit with a history of more recent fuel failures, and increases during an ongoing degraded fuel failure.

Conclusions

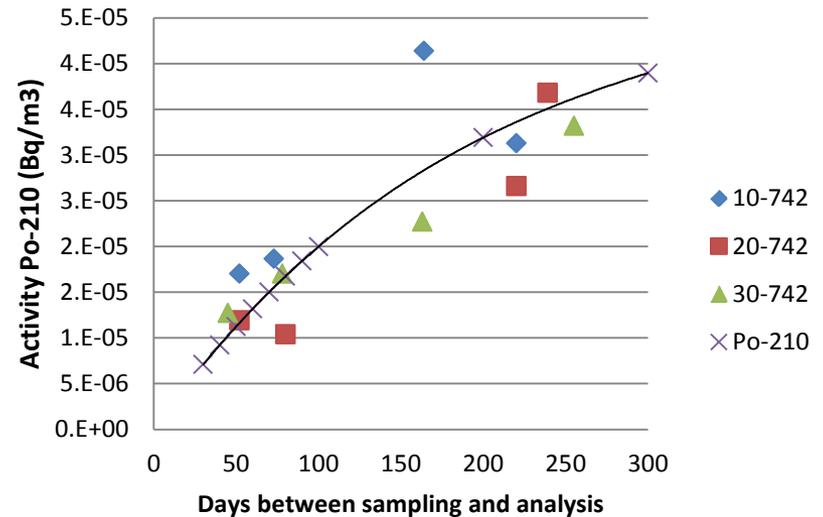
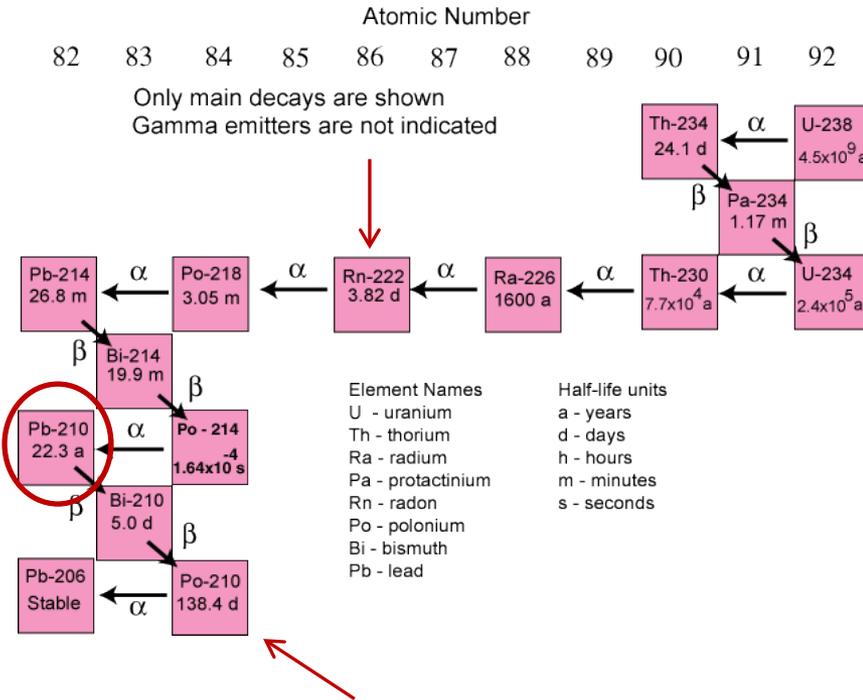
- The level of alpha airborne activity at Forsmark is low.
- The majority of the activity is caused by Po-210, which is a daughter nuclide to Radon.
- Actinides (Pu, Am, Cm) were detected at all parts of the ventilation system, but at very low levels.
- No correlation between the levels of gamma emitting nuclides (e.g. Co-60) and the levels of actinides.
- Turbine building is the largest contributor to the releases of actinides.

Thank you!

Questions?

Americium-243 or Polonium-210?

The Uranium-238 Decay Chain



Conclusion : 96 % of the airborne alpha active nuclides in the ventilation system is due to radon gas.