Uranium Enrichment Determination by Gamma-ray Spectrometry

Contact

jrc-nuclear-inspector-training@jrc.ec.europa.eu [1]

Prerequisites

NDA Physics basic course

Purpose

The course is focused on non-destructive gamma spectrometric techniques for the measurement of the 235U enrichment. The physics and the measurement are outlined, both oriented towards the operational requirements. The complete enrichment measurement procedure including spectrum evaluation and error estimation is discussed. An in-depth review of the algorithms routinely used including conceptual explanations is introduced. Insights into the behavior and capabilities of these algorithms will be developed. Two third of the time is foreseen for practical exercises to make the course participant familiar with the electronic chain, enrichment measurement technique and troubleshooting.

Course content

1. Interaction of gamma radiation with matter and gamma spectrum
2. Types of detectors (Ge, NaI, CZT): principle, structure and performance
3. Signal chain electronics: preamplifier, amplifier and MCA-166
4. Physical, nuclear and chemical properties of Uranium
5. Introduction to the uranium cycle
   - uranium ore dressing and concentrate production
   - uranium purification, conversion into UF6 and fuel element preparation
   - reprocessing of irradiated fuel
6. Enrichment determination: techniques and software
   - method with intrinsic calibration:
     MGAU, principle, and field of application
   - methods making use of standards:
     enrichment meter principle, infinite thickness
     measurement with a Ge detector and UF6 code
     measurement with a NaI detector and U235 code
     measurement with a NaI detector and U235 code

Practicals:

   P 1: Set-up of the gamma spectrometry chain
   P 2: Energy calibration and resolution determination
   P 3: Enrichment calibration with NaI detector (U235 code)
   P 4: Enrichment calibration with Ge detector (UF6 code)
   P 5: Enrichment determination with NaI detector and NaIGEM
   P 6: Enrichment determination with Ge detector and MGAU

Course requirements

   The participant is asked to bring a scientific calculator to class

Note

   The course starts on Monday 9:00 am until 12:00 pm on Friday

Source URL:

Links
[1] mailto:jrc-nuclear-inspector-training@jrc.ec.europa.eu