Uranium aerosols in nuclear fuel fabrication

Characterization work regarding shape, size and activity distributions

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Contents

- Nuclear fuel manufacturing site in Västerås
- Internal dosimetry
- Aerosol characterization work
- Future work

Production of nuclear fuel

- Conversion: UF_6 → UO_2
- Pelletizing
  - Pressing
  - Sintering
  - Grinding
  - Visual inspection

UF_6 = Uranium hexafluoride
UO_2 = Uranium dioxide

Internal dosimetry

- Operations with open handling of uranium
- Airborne activity – inhalation risk
- Chronic exposure by urinalysis
  - International Commission on Radiological Protection (ICRP)

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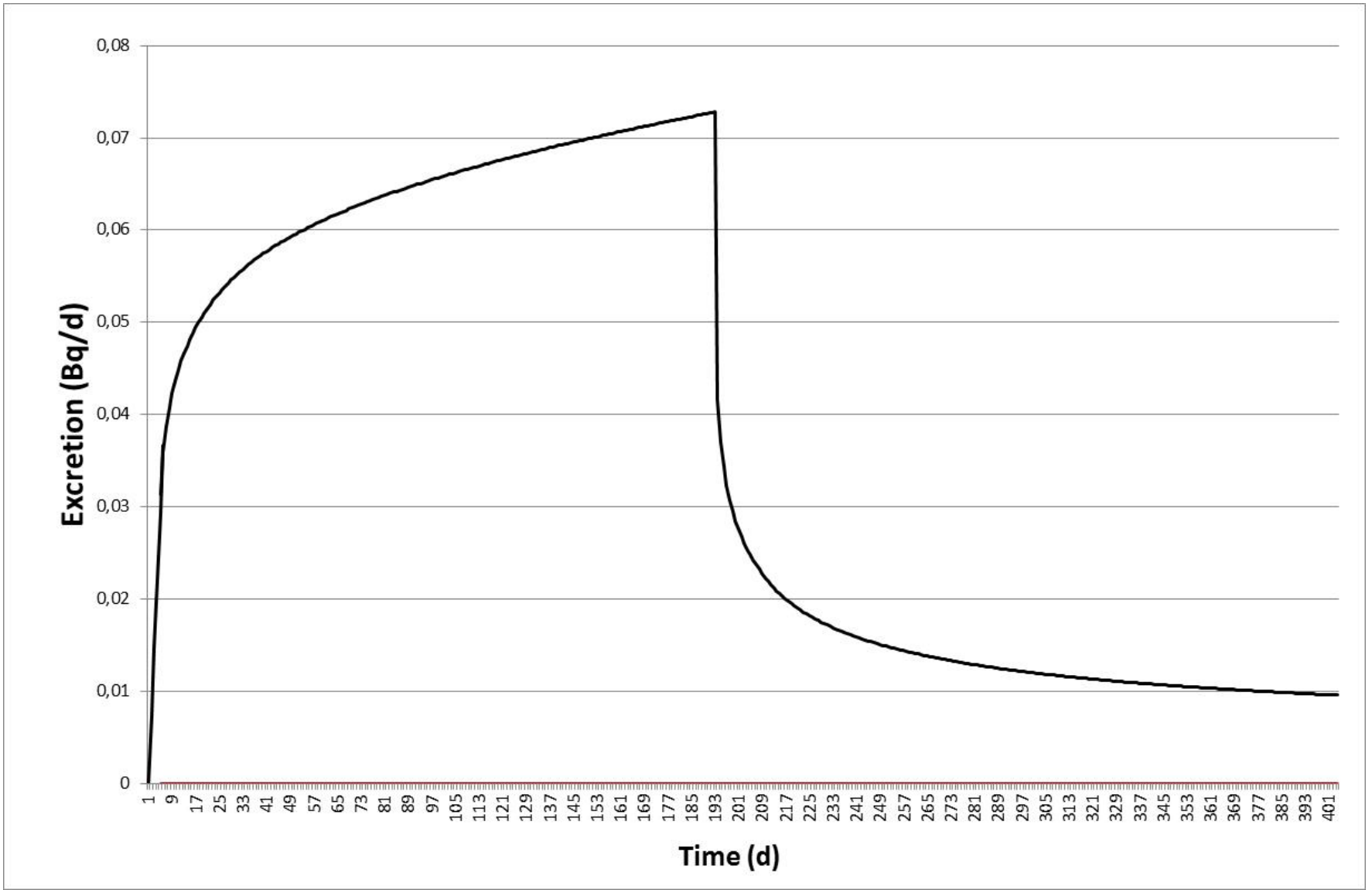
Uranium excretion in urine (chronic exposure) (ICRP 66)



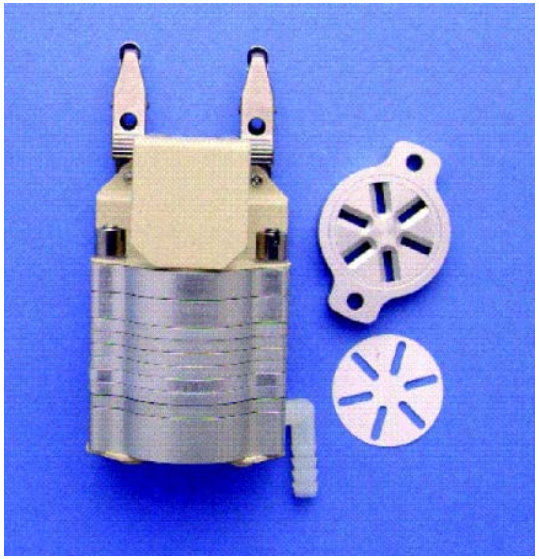
Challenges

- Discrepancy intake levels urinalysis/lung counting
  - Material solubility?
  - Larger particles?

→**Increased knowledge about uranium aerosols required**

Characterization project (ongoing)

- Purpose
  - Increased knowledge about uranium aerosol characteristics
    - Aerosol size distributions
    - AMAD (Activity Median Aerodynamic Diameter)
    - Morphology/shape
  - Future improved dosimetry model
- Methods
  - Cascade impactor sampling
  - Electron microscopy
  - Total activity on filters



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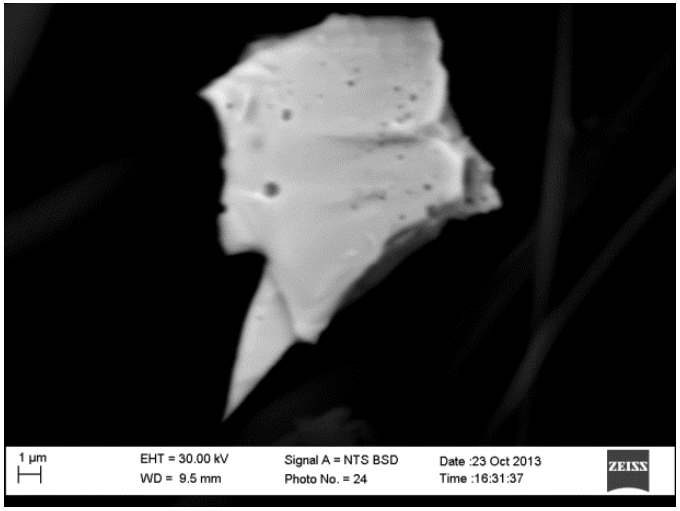
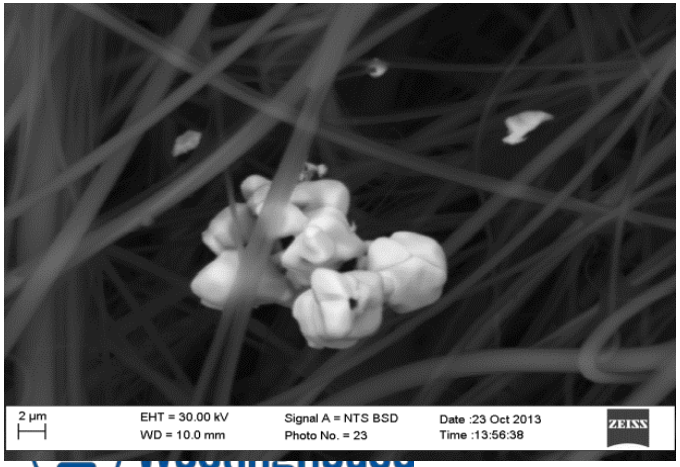
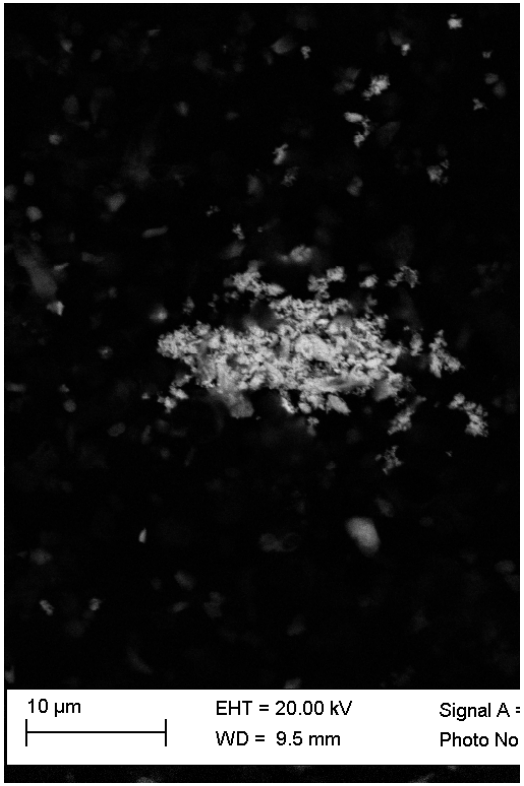
IAEA
International Atomic Energy Agency

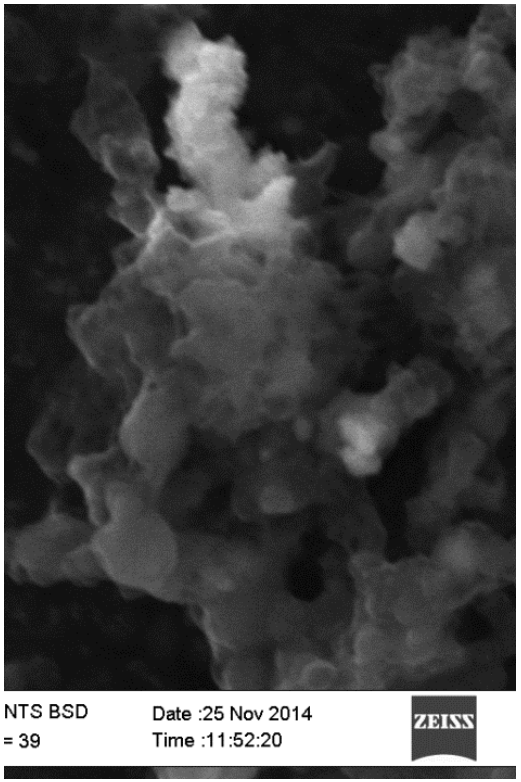
Strål säkerhets myndigheten
Swedish Radiation Safety Authority

Uranium aerosols – Electron microscopy



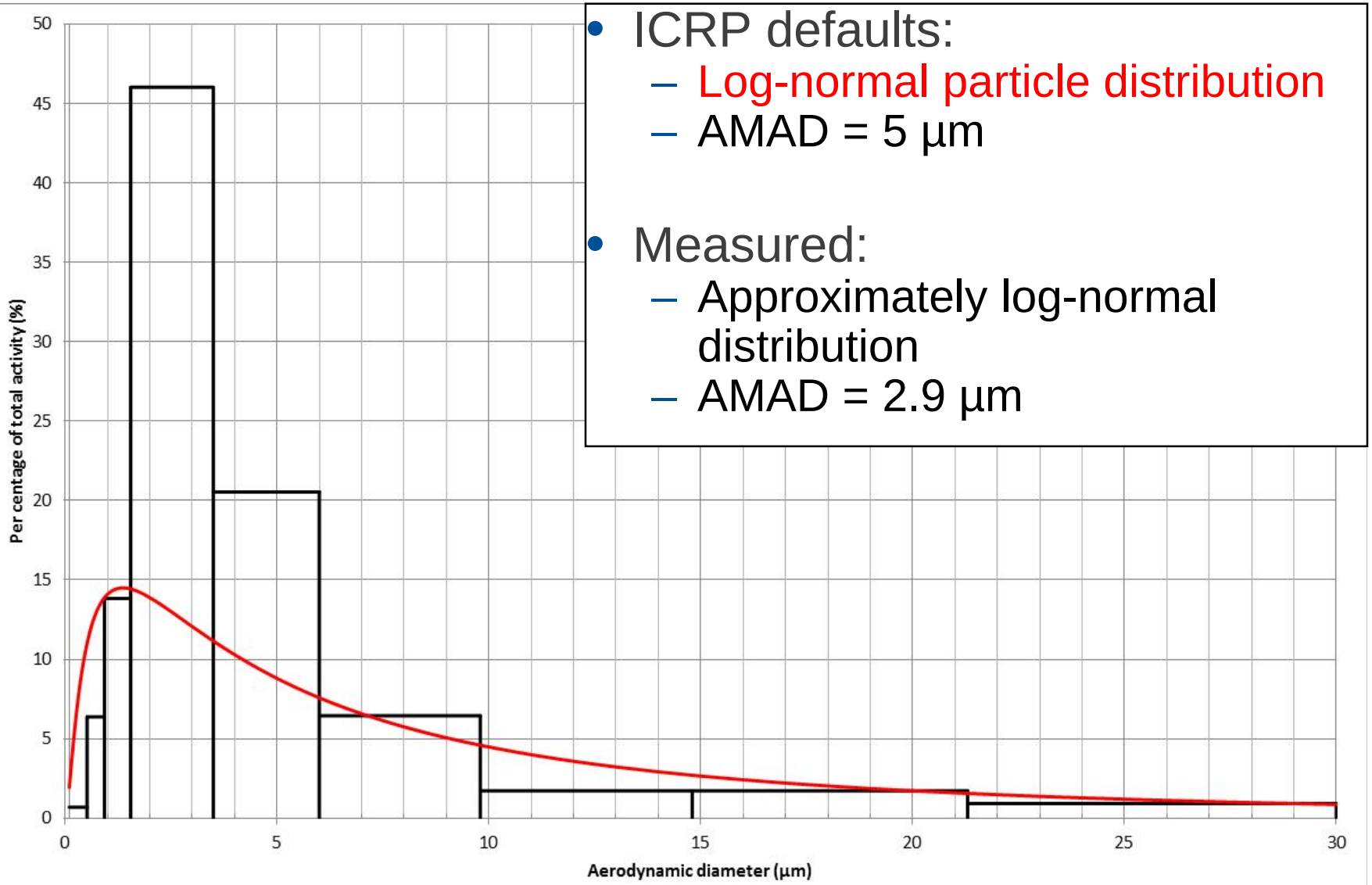




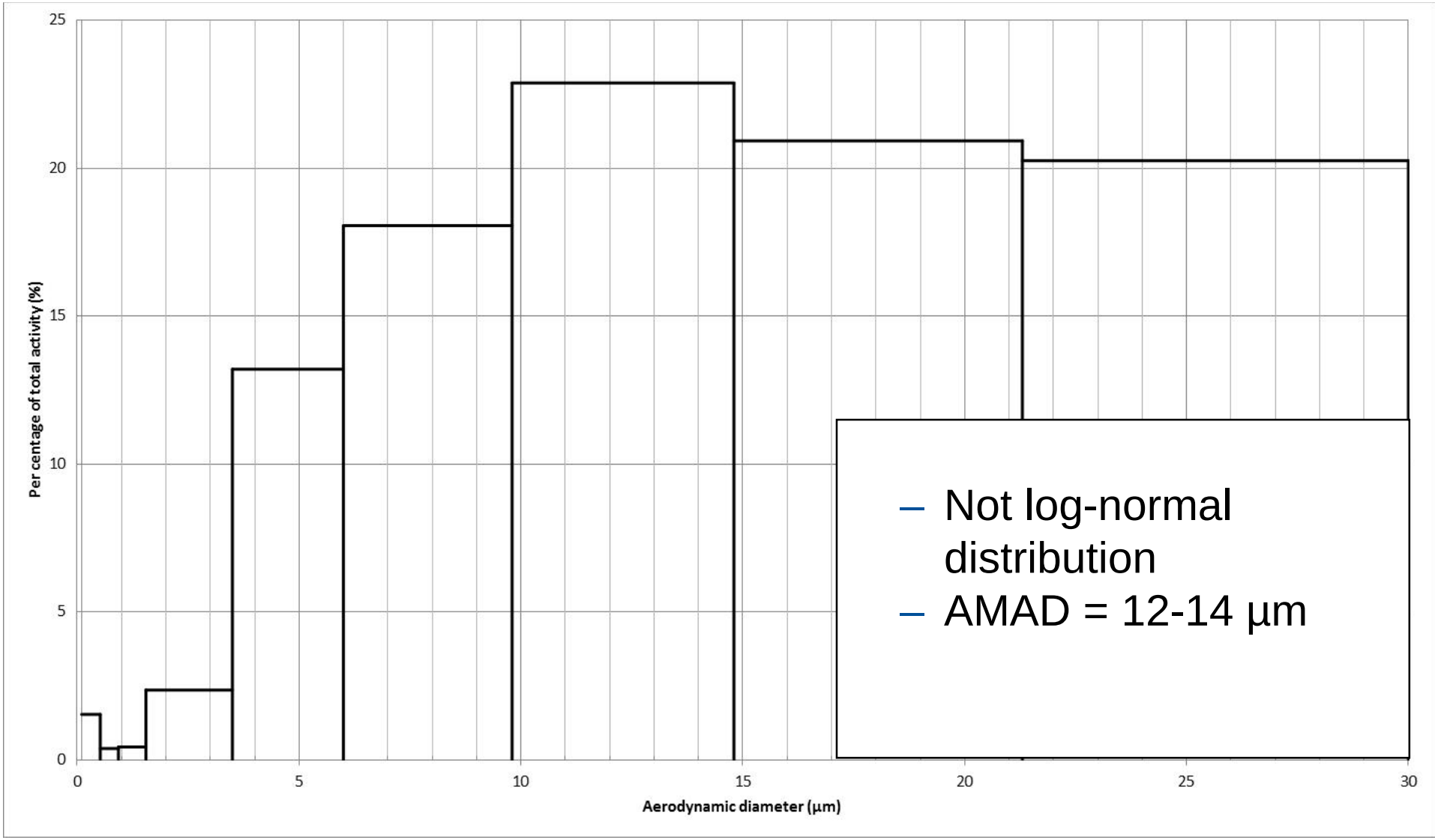


Activity distribution – Milling room

- ICRP defaults:
  - Log-normal particle distribution
  - AMAD = 5 µm
- Measured:
  - Approximately log-normal distribution
  - AMAD = 2.9 µm



Activity distribution - Operator



Conclusions

- Significant variation in aerosol morphology/shape
- Deviations from expected ICRP default values
  - Not always log-normal distributions
  - High AMADs
- Potential effects on dosimetry

Future work

- Additional sampling and electron microscopy
- Solubility
  - Detailed chemical composition
  - Solubility in lung-equivalent solution
  - Excretion studies

Questions?

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