Quality assurance by PET/CT

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→ Legal requirements

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Departement des Innern EDI
Bundesamt für Gesundheit BAG
Direktionsbereich Verbraucherschutz

Abteilung Strahlenschutz
www.str-rad.ch

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Weisung L-09-04
QS Gamma-, PET-, PET-CT Kameras

→ Philosophy

- ✓ Acceptance test
  - × Reference values
    - Manufacturer
- ✓ Constancy tests → daily/six months
    - User
- ✓ Maintenance
- ✓ Status test →every six months
  - × Update of reference value

→ Constancy tests (daily)

- ✓ Check of PM performances (KP-1)
  - Amplification factors
  - Offset
  - Homogeneity
- ✓ Check of energy window (KP-2)
  - Position and FWHM resolution
- ✓ Coincidence timing (KP-3)
- ✓ Subjective check of the overall system (KP-4)
  - Sinogramme observation

→ Constancy tests

- ✓ All these tests are automatic and controlled by PET software
  - ✗ They are not time consuming
- ✓ Should be performed by the radiographer
- ✓ Missing link ?
- ✓ Task of the medical physicist !

→ Constancy tests (each six months)

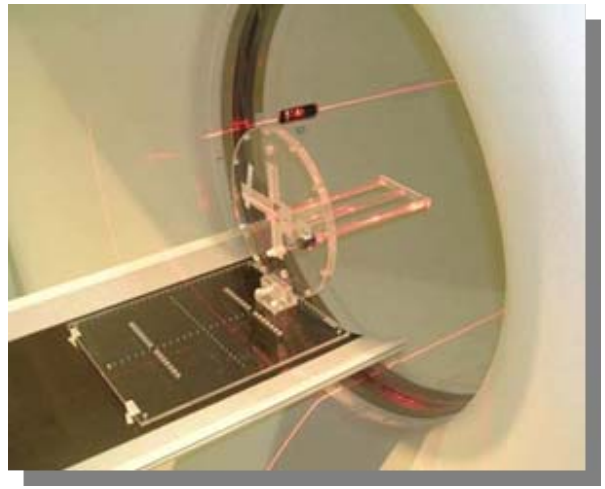
- ✓ System calibration (“well counter”)
  - Homogeneous phantom (NEMA 94, ø 20 cm)
- ✓ Image quality (KP-5)
  - Jaszscak phantom
- ✓ Requires F-18 activity (~ 250 MBq)
- ✓ Radiographer or medical physicist ?
  - Can be quite invasive

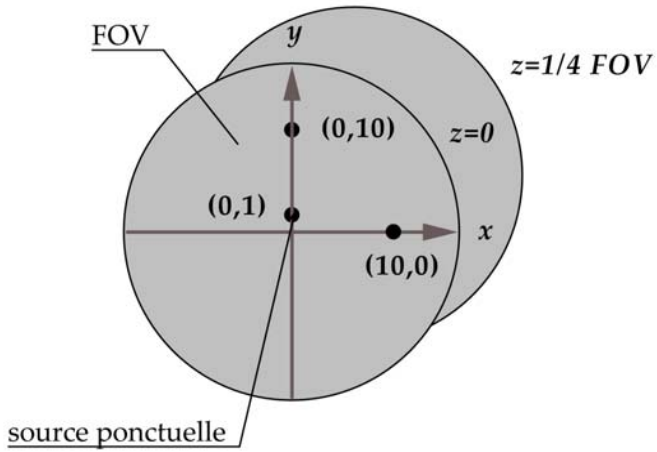
→ Status test (six months)

- ✓ Use of manufacturer's standard procedure (Z-7)
  - Image homogeneity and accuracy of activity quantification
    - Clinical reconstruction algorithms
    - Can be without F-18 (use of solid sources)
- ✓ Accuracy of the attenuation map (Z-8)
- ✓ Image fusion (PET-CT) (Z-9)

→ Reception test – Z-1

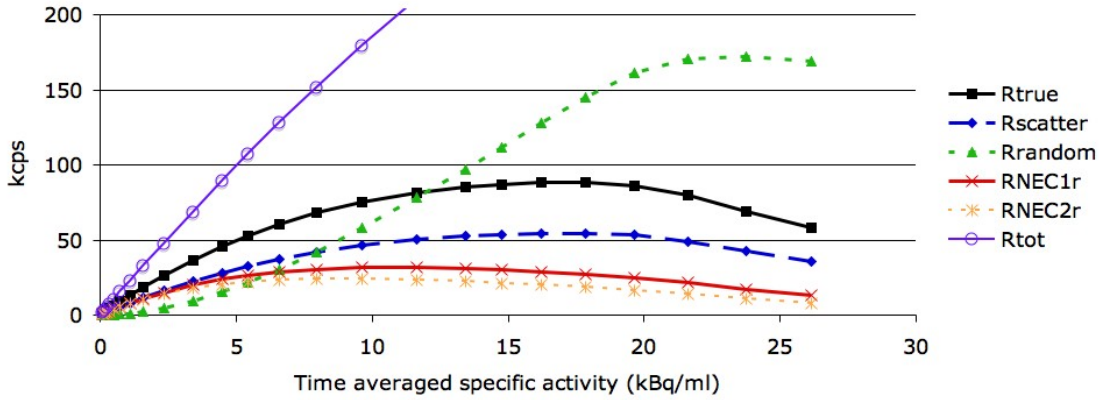
- ✓ Spatial resolution (NEMA NU2-2001, part 3)
  - 6 positions
  - Drop of F-18 (< 1 mm)
    - >150 mBq/ml
  - Careful positioning
  - Quite simple to perform





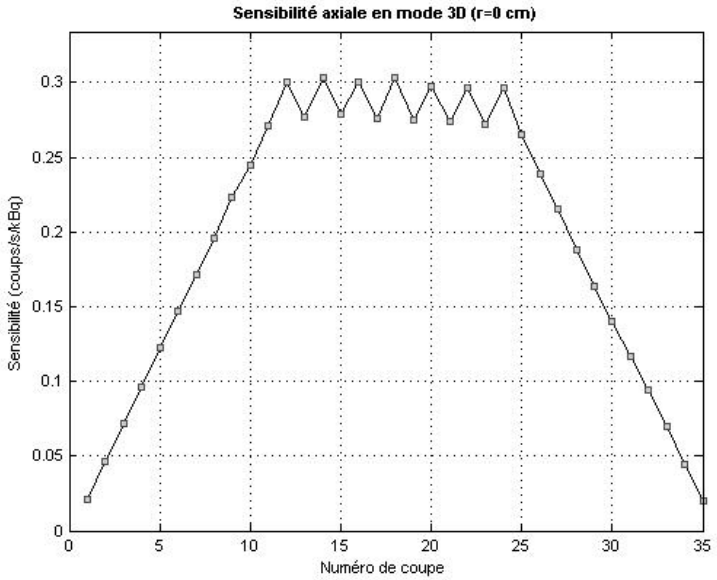
→ Reception test – Z-2 and Z-4

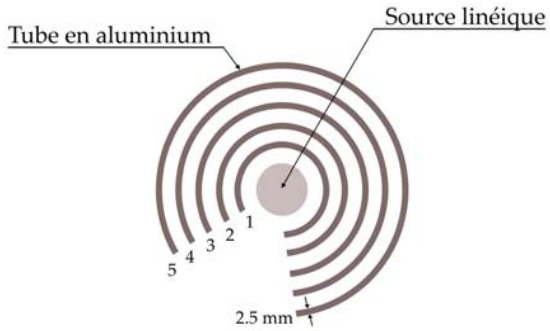
- ✓ NEMA NU2-2001, part 4
  - Scatter fraction, count losses, random
    - 70 cm PE cylinder
    - 1 to 4 GBq F-18
- ✓ NEMA NU2-2001, part 5
  - Accuracy of correction for count losses and random
    - Data from previous test



→ Reception test – Z-3

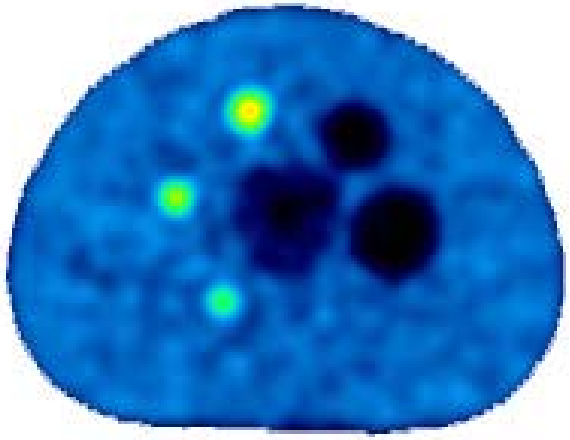
- ✓ NEMA NU2-2001, part 6
  - Linear source
    - Aluminium tubes
    - Extrapolation without tube
    - 10 MBq F-18





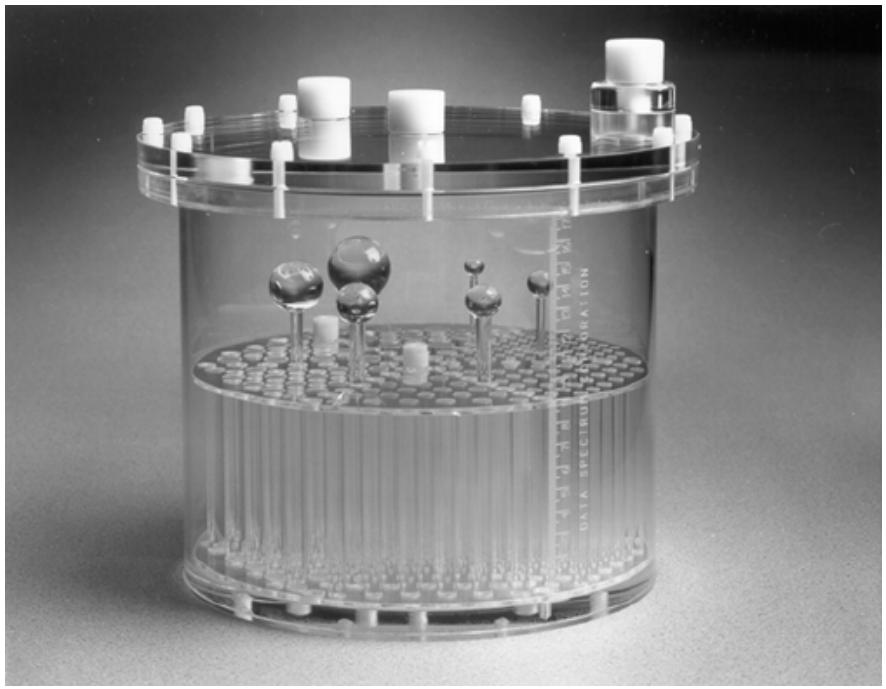
→ Reception test – Z-5

- ✓ NEMA NU2-2001, part 7
  - Image quality I
    - NEMA phantoms
    - 250 MBq F-18



→ Reception test – Z-6

- ✓ NEMA NU2-2001, part 7
  - Image quality II
    - e.g Jaszscak phantom
    - Reference values for KP-5



→ Reception test – Z-7

- ✓ System homogeneity and well counter (NEMA)
  - Cylinder ø 20 cm, length 22 cm
    - Filled with F-18

- ✓ System homogeneity and well counter
  - Manufacturer's method
  - Reference for Status test (Z-7)

→ Conclusion

- ✓ PET-CT units provides quantitative measurements
- ✓ There is a missing link in the QA chain
- ✓ Medical physicists should be part of the QA chain
  - × Commissioning of the unit
  - × Follow-up of the unit
  - × Reliability of the quantitative measurements
- ✓ Article 74 from new Ordinance is our chance
  - × To play an active role in nuclear medicine
    - Not just to help
- ✓ We should take that opportunity to develop a strategy

Round table

✓AAPM definition of medical physicists:

Medical physicists **contribute to the effectiveness of radiological imaging procedures by assuring radiation safety** and helping to develop improved imaging techniques (e.g., mammography CT, MR, ultrasound). They contribute to development of therapeutic techniques (e.g., prostate implants, stereotactic radiosurgery), collaborate with radiation oncologists to design treatment plans, and monitor equipment and procedures".

Radiation safety

- ✓ Importance of medical physics in nuclear medicine
  - ✗ Use of data for Rth Planning
    - CT for TPS

      What for a QA ?
    - Image fusion

      No independent measures

      No interface physician – Radiographer
  - ✗ Use of quantitative measurements for diagnosis
    - Our accurate are the data
    - Major problems mentioned in the literature

      SUV validation ?
  - ✗ Lack of traceability

Round table

- ✓ Should we organize inter-centre comparisons ?
- ✓ Should we propose an manufacturer independent test object
  - ✗ Limitations of Jaszscak phantom:
    - Cold lesions
    - Relatively small
    - Homogeneous
  - ✗ SSRPM working group on that matter ?
- ✓ SPECT/CT is getting used : what approach should we take ?