Measurement of the plutonium hold-up in a melting furnace at CEA Bruyères le Châtel

J.Chevillon, R.Oddou, M.Vincent, H.Schoech

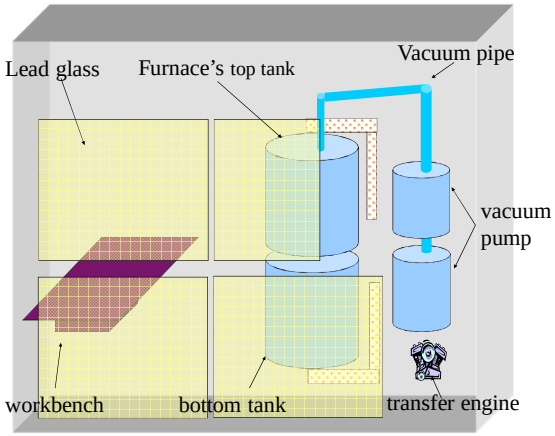
Set of problems:

The installation wants to dismantle a melting furnace which contains fissile materials. The issues are to evaluate the quantity of fissile materials inside this furnace to prevent criticality risk and to manage waste production. The value should be less than 350 g. But the history hold-up (with uncertainty) gives a greater value.

Solutions:

✓ In-situ measurements by gamma spectrometry and passive neutron counting

✓ Provide a measurement system during the dismantling



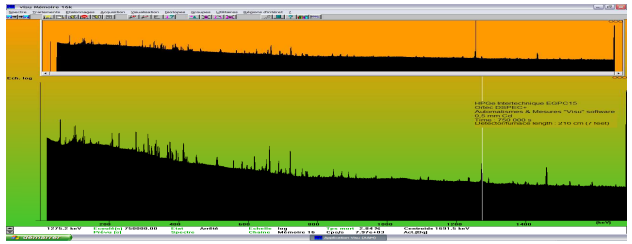
Simplified scheme of the furnace in the glove box

Furnace inside the glove box

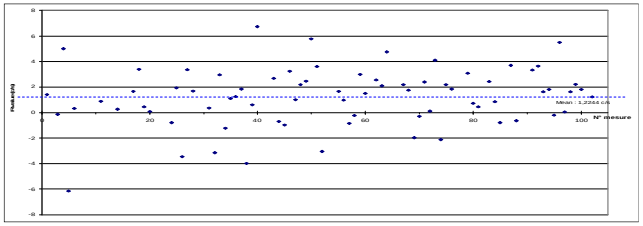
Hold-up evaluation

First runs of measurements:

Measurement of the entire glove box by gamma spectrometry and parts by passive neutron counting.



Gamma spectrum of the furnace



Distribution of the R (real) value for hundred counting

- Identification of the radionuclides
  - ^{235}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am
- Isotopic composition
- Dispersion of the neutron measurements, due to the presence of large amount of Am-241 (α,n) reactions)
- Neutron measurements give a weight of plutonium less than <u>100 g ± 100%</u>

Technical configuration for in-situ measurements:

• Gamma spectrometry : HPGe Intertechnique EGPC15; Ortec DSPEC Plus; Automatismes et Mesures "Visu"; 0,5 mm Cd shield

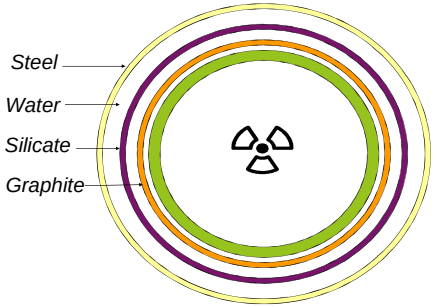
• Passive neutron counting : He-3 tubes embedded in PEHD blocks with Cadmium shield ; Novelec SADN amplifier/discriminator modules; Novelec SADP summation modules; Antech AMSR150 shift register

Measurement of the plutonium hold-up in a melting furnace at CEA Bruyères le Châtel

J.Chevillon, R.Oddou, M.Vincent, H.Schoech

2nd runs of measurements by gamma spectrometry:

4 quadrants (2 for the tank, 1 for each pump)



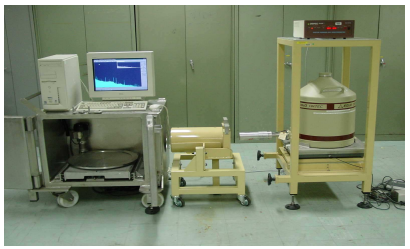
Ex. : Simplified scheme of the bottom tank

- Simplification of the geometry
- Cylindrical elementary volume
- Hypothesis: all of the fissile materials are into the middle of each volume
- Attenuation correction factor due to the layer thickness

Bottom tank: M ≈ 16 g
Top tank: M ≈ 18 g
Vacuum pump: M ≈ 7 g
Turbomolecular pump: M ≈ 7 g

Total: M(Plutonium) ≈ 48 g ± 50 g

Waste management

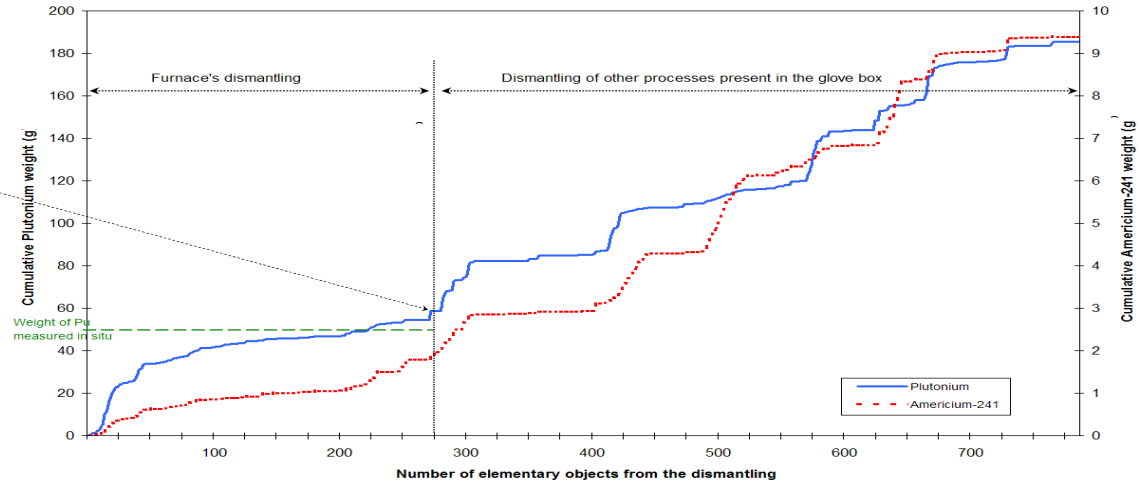


SYDECAR : SYsteme DE CAracterisation Rapide (Fast Characterization System)

SYDECAR : a fast characterization system which could receive 20-L packets or 100/200L drums. It provides the operator a fast way (typically 10-15 min) to decide whether his waste could be evacuated (compared with the specifications of radioactive waste collection centers)

Plutonium weight from the dismantling of the furnace and the pumps ≈ **55 g ± 30%**

Evolution of the cumulative weight of plutonium and americium during the dismantling



Conclusion : By gamma spectrometry, and with simple hypothesis, it's possible to give a reasonable value of the fissile materials contained in this furnace. This is possible due to the relative simple geometry of the furnace. With passive neutron counters, the measure was difficult to interpret, due to the present of (α,n) reactions. But the results confirmed those get by gamma spectrometry. The value from the waste measurements and from the in-situ measurements agree.