Examples for the Release of Buildings and Sites

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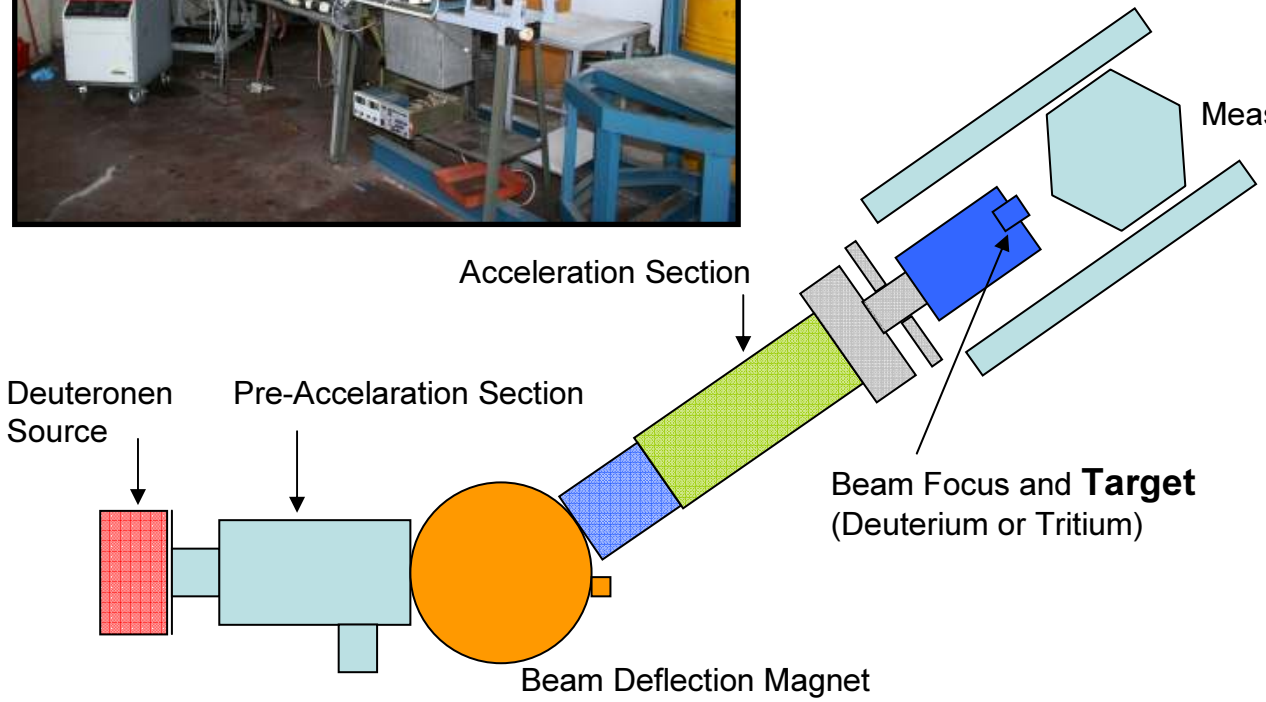
neutron generator

neutron generator

operation period: 1960 - 2000

activation: by neutrons (14 MeV)

contamination: tritium (H-3) out of the generator
handling of tritium targets



$^{2}_{1}D\ (^{2}_{1}d,\ ^{1}_{0}n)\ ^{3}_{2}He$

$^{2}_{1}D\ (^{2}_{1}d,\ ^{1}_{1}p)\ ^{3}_{1}T$

$^{2}_{1}D\ (^{3}_{1}T,\ ^{1}_{0}n)\ ^{4}_{2}He$

situation

a) radiological situation (costumer)

activation (^{60}Co, …) und **contamination** (^{3}H)

- measuring of all parts
- ^{3}H-targets and higher contaminated parts removed, expected low contamination level

b) planed clearance

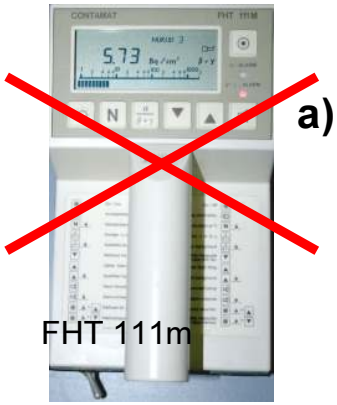
- determination of surface contamination (tritium)
- determination of mass specific activity (^{60}Co, beta emitters)

clearance levels § 29 GRPO, annex III, table 1

^{60}Co	0,1 Bq/g (unrestricted clearance)
^{3}H	100 Bq/cm^2 (unrestricted clearance)
	1000 Bq/cm^2 (reuse of buildings)

preliminary survey: sampling / ^{3}H-determination

wipe, scratch,
drill samples,
direct sampling



a) tritium-monitor

b) wipe samples / direct LSC- counting

not reliable

change in sampling and analysis strategy !

c) scratch and drill samples, combustion/heating, LSC

results of preliminary survey

contaminated layer

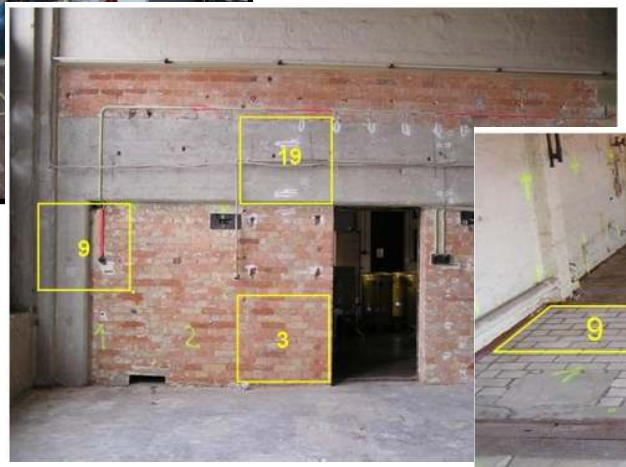
- ^{3}T and HTO in surface layers
  e.g.. paint, wood
- ^{3}H-bond und ^{3}H-release
  material dependent
- wall (max): 42 x clearance level
  floor (max.): 23 x clearance level

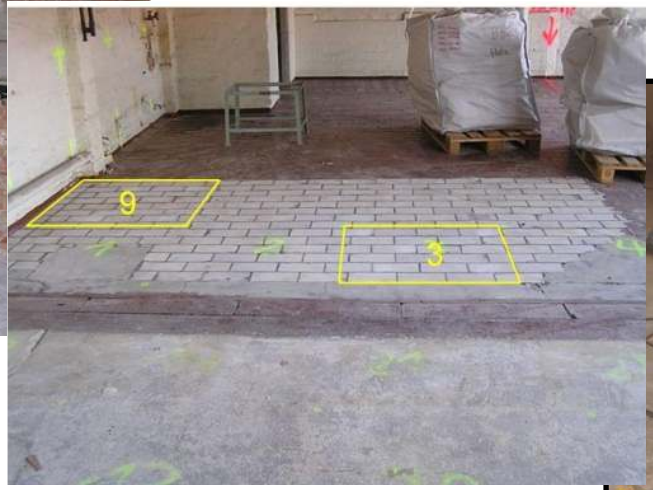
bond of tritium	tritium in paint of	
	steel tube outside	steel beam
to wipe [Bq/cm²]	1540	74
exchangeable [Bq/g]	19	141
strong bonding [Bq/g]	290	240000

no further decontamination of components

removal of material from floor and wall surfaces,
removal of floor covering

dismantling and decontamination



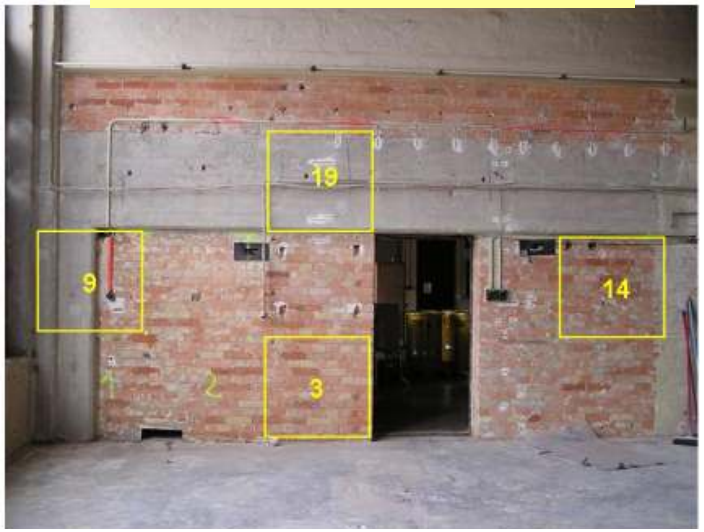


- **dismantling, disassembling, sorting of materials**
- **decontamination of 8 areas (70 m²)**
- **removal by pressured air**
  depth 0,2 – 3 mm

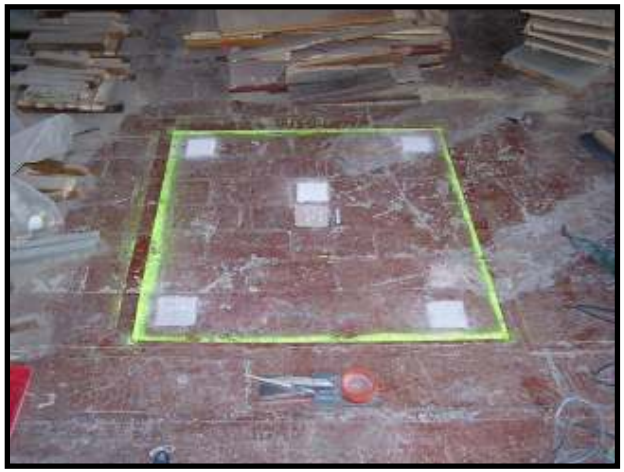
12 control measurements at subareas
max. 21,3 %, mean 2,5 %
of clearance level

test of random sampling

wall



measurement of 10 % of the grid
in 1 m^2 grid areas



analysis of mixed samples
scratch samples of 5 subareas
(each 100 cm^2)

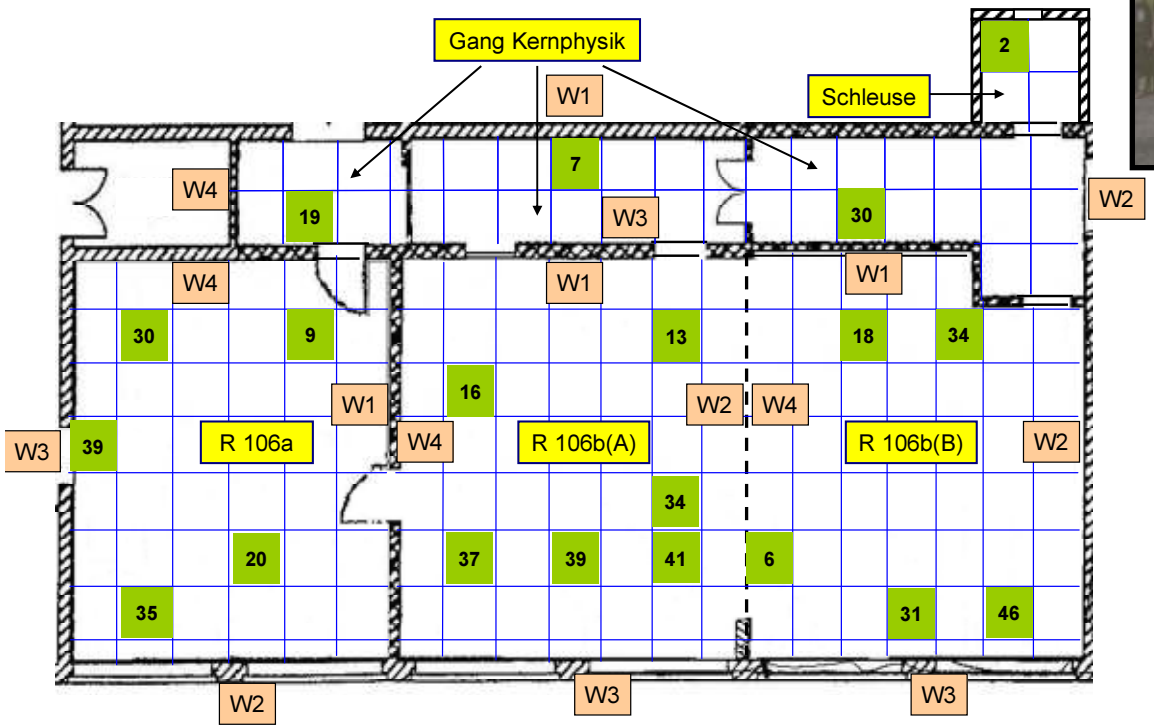
comparison
large area sample (9500 cm^2) vs.
mixed sample (5 single samples)

result: mixed sample is conservative

additional criterion
rise of measurement density in case of
> 50 % clearance level in a subarea

final status survey

in consideration of von 98 measuring points of preliminary survey



results of 55 random samples

range	1 … 472 Bq/cm²
mean	93 Bq/cm²
median	62 Bq/cm²
clearance level	1000 Bq/cm²

unrestricted clearance

incandescent mantle factory

- 1861 patent for incandescent mantles for gas lights by Auer von Welsbach
- “Auer material”: 99 % Th-oxide + 1 % Ce-oxide
- production process
  - flexible tube of polyester silk
  - impregnation with “Auer material”
  - centrifugation
  - washing with ammoniac
  - drying
  - cutting
  - fixation
  - baking

- no consideration of radioactivity of that material in former times
- new regulations for “natural occurring radioactive materials” (NORM)
- investigations of
  - former production sites
  - plants in closure
- survey procedure includes
  - equipment
  - buildings
  - areas outside

- survey techniques
  - gamma dose rate
  - sampling and analysis
    - area
    - depth profile
  - in-situ-gamma spectrometry

accellerators

specifics

- activation by other particles then neutrons
  - other nuclear reactions
- but secondary neutrons may occur !
- different construction materials
  - other nuclides

uranium mining and milling

specifics

- natural radionuclides
  - application of NORM regulations ?
- decay chains
  - normally in radioactive equilibrium
  - may disturbed by
    - chemical processes
    - escape of radon
- analysis
  - gamma spectrometry (e.g. Pb-214, Bi-214, Pb-210, U-235)
  - beta counting (e.g. Pb-210)
  - LSC (e.g. Rn-222)
  - alpha spectrometry (e.g. Th- and U-isotopes, Po-210)
  - scintillation counting (Rn-222 and daughters)
  - ICP-MS (e.g. U-isotopes, Ra-226)

specifics

•natural background

- site specific
- often enhanced

not only valid for uranium mining and milling

•ore mining

•some minerals (e.g. rare earth elements, monazit)

•phosphorite

Thank you for your attention!